The Magazine of the *Whole Earth Catalog*

Whole Earth

Access to Tools, Ideas, and Practices Winter 1999

vital fires

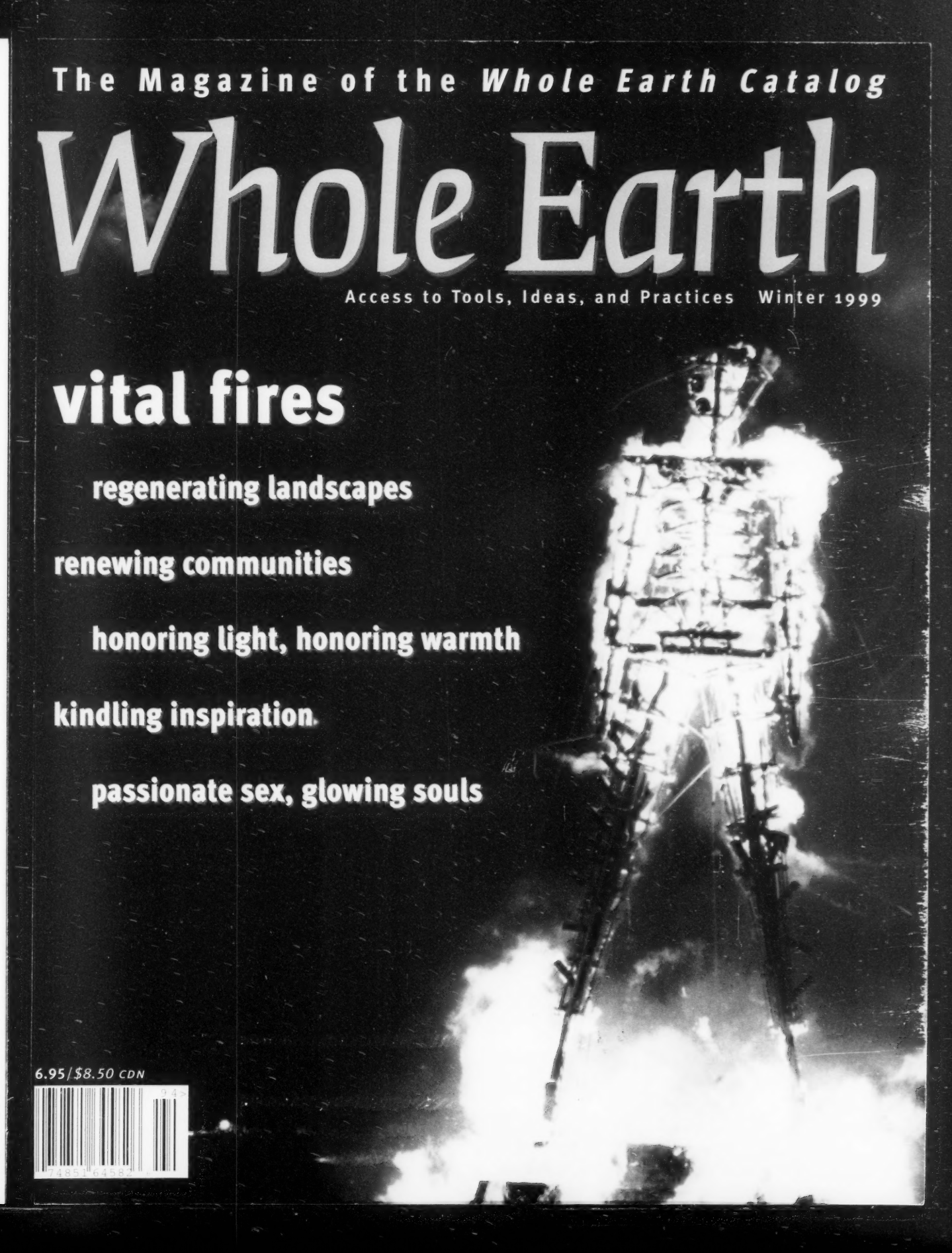
regenerating landscapes

renewing communities

honoring light, honoring warmth

kindling inspiration.

passionate sex, glowing souls



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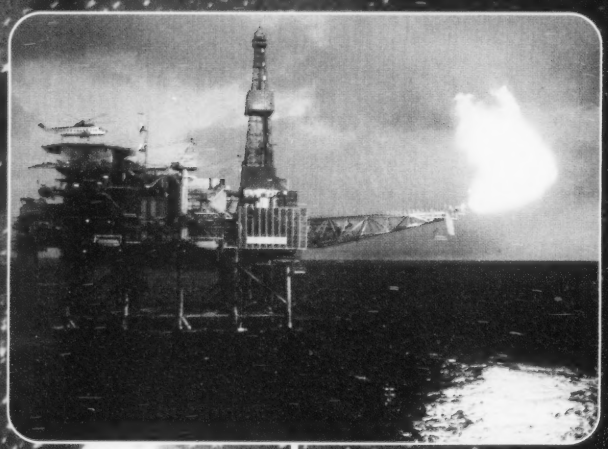
Attention! All

by Stephen J. Pyne

Even as our ecological arguments have matured—recognizing that fire is natural and can be useful, perhaps necessary—the imagery stubbornly remains: Flame is a hostile force or, at best, an unrelenting nuisance that the world would be wise to discard.

Fire's image, particularly on television, animates a message: Fire is an environmental evil, the medium of virtually all the biosphere's larger ills. "Nuclear winter" suggests that a thermonuclear war would, by kindling firestorms, plunge the world into the dark and cold of an ice age. "Greenhouse summer" portrays how the continued



Keepers of the Flame

pumping of combustion gases will turn the Earth into a Crock Pot. Wildfires, sweeping through boreal forests, liberate too much sequestered carbon. Thoughtlessly set fires chew up the tropical forest, slashing and burning biodiversity into kindling and weeds. Crown fires savage Yellowstone, and veldt fires, Kruger National Park. Conflagrations burn into Oakland and rip through exurbs around Los Angeles, Spokane, Sydney, and Athens. Torched oil wells in Kuwait spread an ethereal oil slick across the sky. Coal-fired power plants obscure the Grand Canyon. Gasoline cars smother cities in photochemical smog.

There is nothing even remotely equivalent in the media that argues that fire might have a legitimate role in global ecology; no friendly flame to answer the ugly charges, no image to plead that fire could be something more than the common catalyst in the Earth's environmental wreckage. Or, more properly, there is not yet a story sufficient to carry such an image.

This is strange, and requires, at a minimum, some explanation. The easiest answer is that most urbanite citizens—especially the ruling and clerical classes—no longer have any personal connection with open fire, except what they can experience through TV and print. They no longer tend the family hearth. They no longer burn off the family yard, the pruned branches, the ditches and weeds, the pastures and stubble and fallowed fields. They have no sense from their own intimate encounters that free-burning fire could mean anything other than danger and damage. Even the family-defining fireside is gone, replaced by the virtual hearths of home entertainment centers.

Those more sensitive to environmental subtleties might approve of fire as "natural," but only if it burns in the wild, without pollution of the skies and morally uncontaminated by human hands. They are less certain about anthropogenic fire, because human agency—supplied with free will and a torch—might, like fire itself, propagate uncontrollably. This fear has, philosophically, been a problem with "restoring" fire. What advocates typically want restored is "natural" fire, but the historic landscape that supplies their vision of what restoration should produce was itself the outcome of thousands of years of culturally set burning. The charge to restore commits us to a state of permanent irony.

"Ceremony, Sri Lanka," Linda Connor (1979)

We will never decide to what point in the past we should restore the land—and can never, in any event, actually get back there. There is no reason, however, to encumber the debate in this way. We have ample reasons to burn: Burns exist in nature and in the landscapes humans have sculpted; they can help maintain diversity; they exist in our genetic legacy as fire keepers; they are inalienable parts of our cultural heritage of fire reverence. What matters is which fire regime is best on a site-by-site basis. What matters is finding a story to allow us to make those judgments, not because we want to restore a past but because we want to reclaim a future.

In fact, the story we need already exists. It is the oldest of all human fire stories (the one found in every culture), in which we acquired, trapped, or stole fire as our own. The "story" is that fire is perhaps our defining ecological trait, it is what we do that no other creature does. It appears to be our job and destiny to see that it is used properly in the world. Not to extinguish it, not to burn everything in sight, but to somehow get the right mix of fire in the world for both our interests and those of others.

Seizing the forbidden flame was a Faustian bargain. While we came equipped genetically to possess fire, we lacked any instructions on how to use it properly. Yet no neutral position is possible. We took fire's power; we have to assume its responsibilities as well. The origins story tells it all.

The time has come to recover that narrative, to become friends with fire once again, and to reclaim our heritage as keepers of the planetary flame. ❀

Opposite: Rooted in ancient cattle-raising and purification rites, a bonfire in Spain honors San Antón, patron saint of domestic animals.

Opposite, top inset: Blowing off oil-rig vapors. Bottom inset: Forest fire—holocaust or renewal?

Spanish bonfire photo from *Festivals & Rituals of Spain*, Cristina García Rodero. Harry N. Abrams, 1994. Used with permission. Inset photos from *Fire*, Hazel Rossotti (out of print).

Whole Earth 99

Winter 1999

Special: Celebrating Fire

Can fire be our friend—renewing, vital, creative; honored for its light and warmth, and for its bodily and community life support?

Dear Reader,
This issue has been overwhelmed by friend contributors. Take your time. It is more than a two-hour-airplane or two-day-then-into-the-trash read. Minimally, peruse for three months!
—Peter Warshall, editor

Attention! All Keepers of the Flame Inside front cover *Stephen J. Pyne*

Vital Fire: Introduction *Peter Warshall* 4

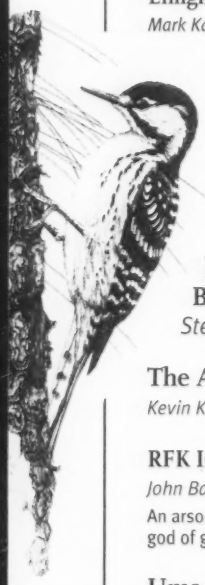
The Long Burn 6
Stephen J. Pyne
A two-billion-year history of fire on our planet.

Stephen J. Pyne *Peter Warshall* 14

Burning Mirrors *John Perlin* 16

Biospheric Fire, Fire-Loving Species 17
Animals that need fire.

Enlightenment in Burnt Forests 20
Mark Kaib on tree rings as libraries.



The Fires of Life 22
Harold J. Morowitz
We are beings of cellular heat. The story of how cells burn the fuels of life.

Soul Fire *Peter Warshall* 26

Need-Fire: Kindling New Fire; the Basic Rite of Community Renewal 27
Stephen J. Pyne

The Art of Burning Man 28
Kevin Kelly

RFK Is Gonna Burn 31
John Barracato with Peter Michelmore
An arsonist takes orders from the queen of space and the god of gods.

Uma and Shiva, or The Origin of a Young God *Sadie Hadley* 34
Inner heat of ascetic meditation and sensual karmic love ignite a love affair to save the world.

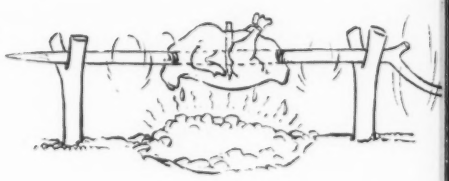
Domestic Fire *Peter Warshall* 40

Fire-Starters: A History of Ignition 41
From carrying hot coals to the disposable Bic.

Can Waste Charcoal Powder Save Forests? 43
Elsen L. Karstad
In Kenya, recycling waste charcoal may save virgin trees.

Hands-On Fire-Crafting 45

Tapping the Sun *Joe Schwartz* 48
The latest in solar tech.



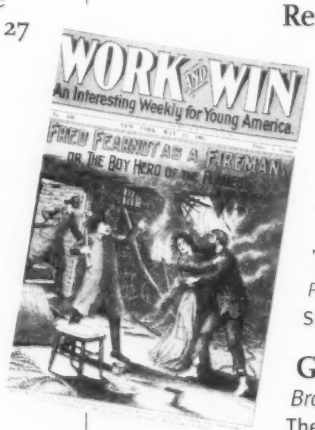
Cooking with Fire 50
Daphne Dervin

The Hysteria Fire: New York, 1741 53
John V. Morris
The cruel entanglement of fire and witchcraft.

Burning Libraries *Stewart Brand* 56

Bright and Warming Flames 57
Letters to the victims of burnt churches, from the Anti-Defamation League.

Wildlands: The Firefight *Stephen J. Pyne* 59
Fire suppression versus fire prescription.



Restorative Fire Is Local Fire 61
Robert B. Hansen on restoring fire's creativity the San Joaquin grasslands.

Mixing Fires, Mixing Stories 66
Stephen J. Pyne

Nude Ranching *J.D. Smith* 68

To Burn or Not To Burn 69
Peter Warshall and Michael K. Stone
Should we incinerate our garbage?

Green Chemistry 71
Bradley Pine
The new alchemy desires chemistry without harm.

Fighting Fire with Fire 76

The Hierarchy of Vital Fires: From Inner Heat to Cosmos 77

HOMEPLATE

The *Wild* Rice Moon 78
Winona LaDuke
Native-American rice, people, and life confront the commodity markets.

Wow! The Earth! E-Mail from MIR 88
David A. Wolf
Astronaut Wolf's journal of domestic life in outer space.

The Vermont Guide to Computer Terms 101

Choose Your Sperm 103

Outbursts of Creativity: The Nine-Dot Problem 107

BOOKS & RESOURCES

FIRE

BioCycle 70
The Deep Hot Biosphere 25
Dubé Catalog of Juggling Equipment 39
The Ecology of Fire 64
***Fire Cookbooks* 52**
- La Parilla
- Know Your Fire
- License to Grill
- The Complete Meat Cookbook
- Smokehouse Ham, Spoon Bread, & Scuppernong Wine
- Sticks & Stones
- Home Smoking and Curing
- The Bread Builders
- Microwave Gourmet

Fire Management Notes 65
Firesetting Children 33
From Space to Earth 47
Home Power 49
Keepers of the Flame 40
The Psychoanalysis of Fire 37
Stephen J. Pyne Books
- America's Fires 64
- Burning Bush 14
- Fire in America 14
- Fire on the Rim 67
- Vestal Fire 14
- World Fire 14

Recycling & Incineration 70
Rites and Symbols of Initiation 37
WILDFIRE 65
Wildland Firefighter 65

COEVOLUTION

Ag Biotech: Thanks, But No Thanks? 102
The Clock of the Long Now 95
Conceptual Blockbusting 109
Farmageddon 103
Natural Capitalism 96
Our Dumb Century 94
Seven Wonders 106
The Story of Colors 104
***Tech Reviews* 98–100**
- Information Ecologies
- The End of Patience
- Questioning Technology
- The Pattern on the Stone
- Close to the Machine
- Technology Forecast 1999
- E-Business Technology Forecast

Wild Duck Review 102
Zapatista Social Netwar in Mexico 104

HOMEPLATE

All Our Relations 81
4 Steps to Financial Security for Lesbian and Gay Couples 93
Full Moon 86
Green Teacher 85
How to Create and Nurture a Nature Center in Your Community 85
In the Company of Mushrooms 84
Medicine for the Outdoors 92
The Moon Book 87
Plant Propagation 82

HOMEPLATE CONT'D

The Rose's Kiss 83
Sheep Shears for Harvesting & Pruning 83
The Whole Parenting Guide 92

FIRE ACCESS

Access to Ashes 70
Book and Church Burning Access 58
Charcoal Access 44
Classic Fire-Crafts 46
Fire Books and Map Access 15
Fire Cooking Access 51
Firefight Greats 67
Green Chemistry Access 75
Ignition Access 42
Incendiary Access 76
Juggling Access 39
Metabolic Access 24
Pyrotechnical Access 38

Solar Access 49
Tree-Ring Research Access 21
Wildland Fire Access 64

OTHER ACCESS

Wild Rice Access 81

BACKMATTER

Gossip 110
Book Brawl III and Other Letters 111
Thanks and Corrections 113
Giving to *Whole Earth* 115

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Whole Earth

WINTER: 1999

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SUBSCRIPTIONS: In US $24; in Canada $32 (includes postage and GST); elsewhere $39 (US funds). For customer service, write *Whole Earth*, PO Box 3000, Denville, NJ 07834-9879, or call 888/732-6739.

Whole Earth (ISSN 0749-5056) is published quarterly by Point Foundation, a nonprofit educational organization, 1408 Mission Avenue, San Rafael, CA 94901-1971 (415/256-2800). Periodicals postage paid at San Rafael, CA and additional mailing offices. POSTMASTER: send address changes to *Whole Earth*, PO Box 3000, Denville, NJ 07834-9879.

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Above: A classic vilification; fauna of every stripe hotfooting it away from fire in utter panic. Illustration from a Welsh postcard.

Vital Fire

by Peter Warshall

Introduction to this Issue

Rowan, fourteen months into this world, was in my arms, waltzing among partying humans. He had never been held by his godfather, and never likes things "away from mom." We stopped at a candelabra. Hooked, his eyes watched flames. Comfort enveloped us and the flames flickered majestic. I took down a candle, played the flame up and around the wick with every kind of exhale, then blew it out and re-lit it. Rowan never blinked, tried his best to puff, but it was a tremendous flame for his meager wind and skills.

Clinging flame, clinging kid; the heart of *Whole Earth*'s intentions for this issue. In our bodies, watersheds, and biosphere, in the next century, how can we honor fire's vitality, its powers to purify, fascinate, and sculpt both desires and landscapes? Can we restore fire as a friend?

Readers must truly take their time, as we have dedicated more pages to this theme (almost eighty) than to any other to date. The staff put in overtime, tending simmering pots of prose. Our fireman to the intellectual rescue was Steve Pyne, who penned five catalytic essays.

I was on radio during production, and the DJ said with confidence: "Earth, air, and water...the twentieth century sure made a mess of those." I wanted to toss my headphones, preach fire and brimstone: "Denial, everyone's in denial. Fire was lost after it had been cherished. We've become beggars of minimalist pyro-experiences—lighting birthday, emergency, or dinner candles; a cigarette or a joint; occasionally a stove or a barbecue. Ignition is too easy, a disposable Bic; or too hidden, in car spark plugs and electric-stove pilots. So few ask: Is this burning—furious or loving, cellular or biospheric—the kind we want?"

As the issue unfolded, we discovered that acknowledging "vital fire," fire crucial to creativity on the planet, was not easy. There are no children's books, for instance, that honor fire. Many of the best adult books are out of print. There is no central access, no tool kit arranged by bioregion for managing the diversity of renewing fire.

Whole Earth editors scanned the horizon for the good news smoke signals. We found a ripening restoration ecology movement, bringing into harmony local knowledge of seasonal burns and biological diversity; and a globalocal passion to stop Amazonian, African, and Southeast Asian forest conflagrations set by slash-and-burn impoverished peasants, thoughtless cattle ranchers, and palm-oil plantation entrepreneurs.

A new "alchemy" is emerging, with new moral strictures that push for a greener chemistry that inflicts no harm on people and the environment. Perhaps most hopeful is the new critical eye cast at fossil and nuclear fuels and combustion. More people ask: Are these fuels vital? Can they be phased out?

Each peek at a topic stirred up new fire quests. For instance, we discovered new esteem for our highly evolved cells, which have tamed the flame and inter-

Fire-in-Watershed Quiz

- Where do the fuels for the fires in your life come from? For heating, cooking, food preservation, lighting, transport, air-conditioning, and other products you use?

- What food-fuels do you ingest to support your body's "fire of life"? What oxidants or antioxidants?

- How do you ignite the fires in your home? How does ignition occur in your watershed?

- When you toss garbage, is it incinerated (fast burn), composted (slow burn), or landfilled?

- Is your garbage toxic when burned or composted?

- What was/is fire's importance in your watershed? How does combustion help and harm the place you live?

- What animals and plants in your bioregion need fire? Can fire be restored to the landscape?

- Do you or does your community pay reverence to fire's gifts? Is there a celebratory fire or event that honors fire's ability to create and regenerate? Any pyro-honoring stories told?

nalized the "burn," slowing it down, keeping reaction temperature too low to combust our organs. Humans now play with cell fire. They want to balance cellular oxidants and antioxidants in a quest for health and longevity. We have begun to employ other oxidants, such as fluorine, to replace oxygen in the manufacture of artificial blood.

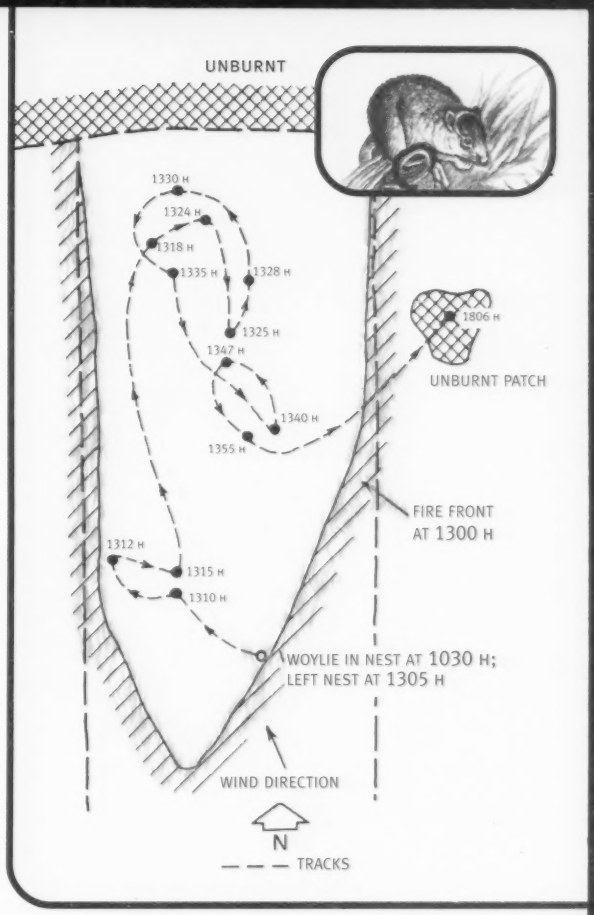
Other pyro-enigmas, such as the loss of "perpetual fire" and "new fire" rituals, were even more mysterious. For millions of years humans carried fire as hot coals they had stolen from nature. The general love for and benefits of keeping the flame alive have deteriorated into the "eternal flame" of the military and the nation-state. Local communities have forgotten it. Similarly, after humans learned to be fire-starters, "new fire" celebrations honored our unique ability to willfully ignite grass for greener pastures and fields for more robust crops; to start courtship with passion; and to bind household fires to a communal flame. Where are the "new fires" now?

Steve Pyne describes how we lost these values: how urban intellectuals and media promoted unbalanced images of fire-as-threat; how one-match/one-man democracy scared the nation; how a pyrophobic Europe exported fire suppression to its colonies. Ironically, "Enlightenment" science dethroned fire from its high profile in the earth/air/water/fire Element Quartet. By the twentieth century, fire was just one manifestation of heat, which was just one manifestation of energy, which had at least four other forms (mechanical, chemical, atomic/radiant, electrical). The technicians of fire, specialized and divorced from the sacred (who knows how the petro-shaman cracks crude oil?) hid combustion in special ovens, furnaces, and chemistry labs. Only recently have citizens probed the pyro-elite about their moral ties to community and planetary health.

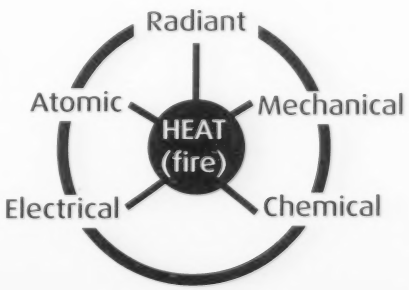
Fire and Water

Until this issue, I was a water watcher. I made fires, sat for hours near them, adjusted them. This issue reorganized my fireside memories. Fire's scarier than water. It self-generates, self-perpetuates, tends toward the excessive. The heat of fire dries out nearby fuels, igniting them, creating even more fire. Fire's qualities are transportable; they can be reproduced from carried embers like a seed. Water cannot be seeded—carrying around a cup of water does not generate more rain. Fire, unlike water, changes into a new state that cannot be reversed. Ice can become liquid can become mist can become sleet and back again. We recognize it. But fire disappears into an invisible web of moving heat, mysteriously nurturing some new event,.not easily traceable. Water stays close. Fire as heat is boundless, escaping beyond the biosphere.

Gawking at embers, I can no longer contemplate my own vitality independent from the flame's. ❀



Movements of a woylie (an Australian marsupial) during a high-intensity fire in a eucalyptus forest. The woylie remained close to home, doubling back through the fire front and resting in a patch of unburnt plantlife. No fear or fleeing as depicted in the Bambi saga. Map from *The Ecology of Fire* (see page 64).



Fire—the process of combustion accompanied by heat and light—is no longer experienced as a singularity. Fire has become a special case, just one manifestation of energy and matter. Kinetic energy, radiant energy, chemical energy, and nuclear energy could all create heat and light, but did not require fire. Glowworms emit cold light. Cells burn sugars without caramelizing. Sunburns occur without flaming epidermis. Humans now exquisitely control fire and heat. But we utilize other energies to heat (e.g., microwave cooking). Fire has lost its special glamour.

The Long Burn

Seizing fire was our most daring, our most profound gamble. It made us the biospheric creature we are. It made the biosphere anew.

by Stephen J. Pyne

We didn't invent fire as we did things to make and use it, like candles and matches. It was already out there—has been on the planet for at least 400 million years. And it will outlive us, all of our monuments, all our words. When the Earth itself ends, it will likely do so in a flash of solar fire. But fire's Earthly origins were far less explosive.

The early Earth had plenty of sparks. Even today lightning is a more than ample source of ignition. But those bolts had to strike something that could burn, and in any event, burning required oxygen, which the early atmosphere lacked. Life furnished both: The atmosphere became saturated with oxygen, and plants encrusted the land. What photosynthesis put together, combustion pulled apart. The "slow combustion" of respiration acquired a more vigorous twin with the "fast combustion" we call fire. Beginning with the Devonian, fossil charcoal began to litter the sedimentary record.

Above: "Fallas," from *Festivals & Rituals of Spain*, Cristina García Rodero. Harry N. Abrams, Inc., 1992. Used with permission.

The fire triangle is the recipe for open flames. Provide fuel, maintain air, and ignite. Where do your fuels come from? How do you ignite them?

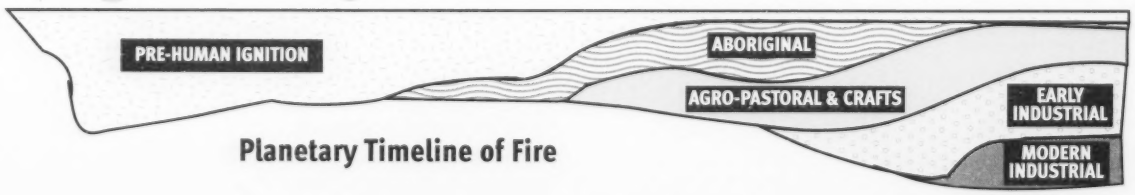
Over time, the fire triangle's sources change: new fuels, new ways to ignite fire, and even new combustible gases.

AIR: To air-nurtured fire we add human breath; then bellows; then pure oxygen with special pumps; and finally, new oxidants like fluorine and bromine.

FUELS: Easily collectible materials (wood, straw) are joined by geologic coal and oil, then uranium, and maybe hydrogen .

IGNITERS/ENERGIZERS: Start with volcanoes and lightning; add human-kept embers, and then igniters like matches; then catalysts and photons.

Whole Earth tracks these changes over two billion years, as non-human, aboriginal, agro-pastoral/crafts, and early and modern industrial fire traingles mutate. THEY DO NOT REPLACE EACH OTHER. As this century turns, they all coexist, though the aboriginal fire triangles have shrunk in importance, and the industrial fire triangles dominate.



Planetary Timeline of Fire

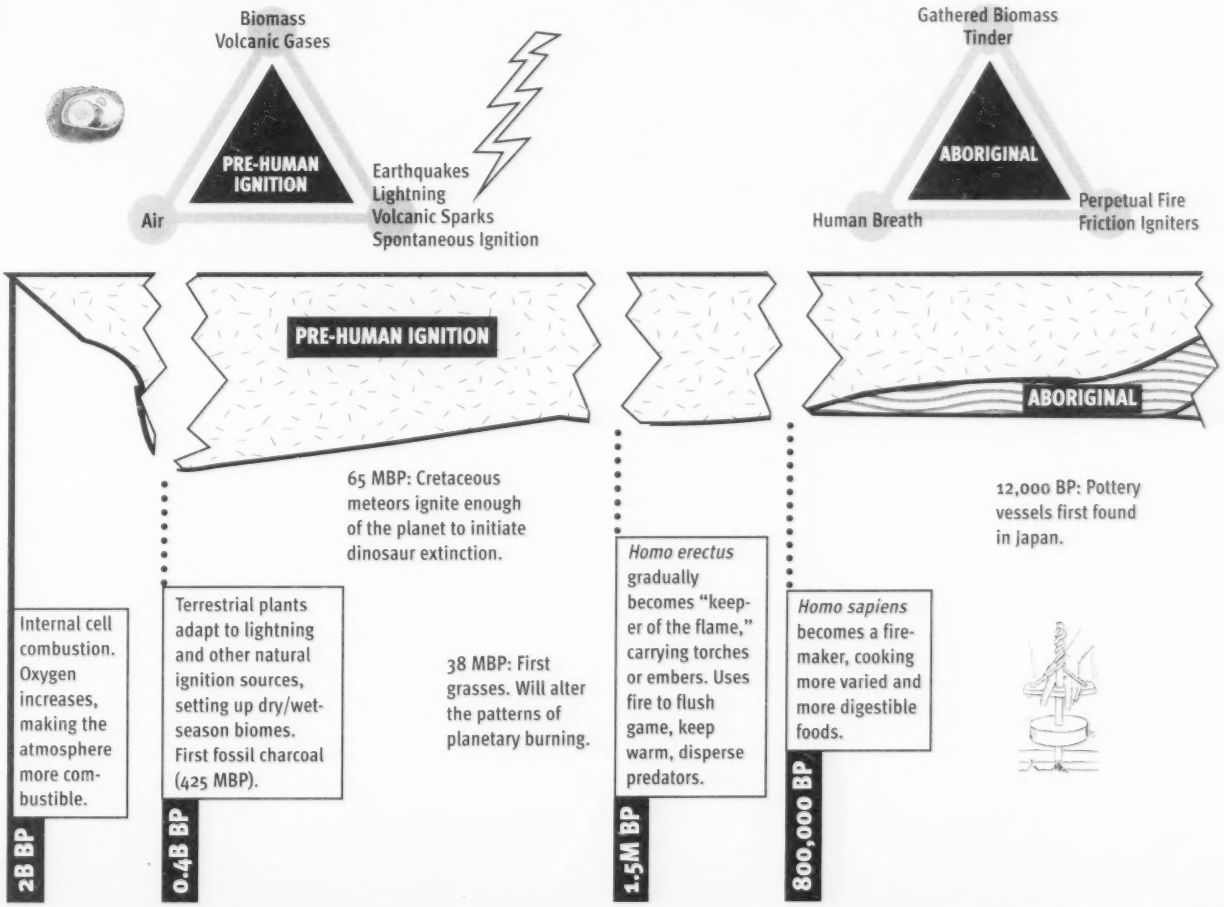
Illustration by Stephanie Johnston.

So we did not invent fire. We captured (stole, seduced, tricked, pried, wrested) it away from nature. This was a profound moment for the natural history of the Earth because it changed how and where fire worked. Natural fire is lumpy. Naturally ignited fire occurs in patches and pulses, driven by a two-cycle climatic engine of wetting and drying, shaped by the kinds of biomass that may or may not thrive under such a regime, waiting on lightning's lottery to kindle. Much of the Earth doesn't burn. It is too wet, too icy, too sparsely vegetated. Over much of early Earth history the mix so often failed to kindle that vast quantities of biomass were simply buried. Nature's economy, in brief, lacked a broker that could match flame with fuel.

CAPTURING SPARK

That changed with the later hominids. It seems that *Homo erectus* could tend fire, could keep it alive in caves or hold it in torches or slow matches. Probably not until *Homo sapiens*, however, could humans start fire more or less at will. The standard technologies for kindling fire by striking, drilling, or rubbing are the same as those developed at that time for working stone and bone. Still, it was easier to keep fire alight than to constantly rekindle it; guarding the perpetual fire is a very old (and very practical) habit. The sputtering flame became constant, something that accompanied people wherever they went; and they went everywhere. One species had acquired a monopoly over fire that it would never willingly surrender.

Since the first tread of *Homo sapiens*, fire ecology has thus meant human ecology. The biosphere had long exercised some control over fuel and oxygen, since life produced both. In human hands, a living part of the biosphere—us—could in principle exert some power over ignition as well, and bring fire's triangle (spark, fuel, and air) more closely into the cycle of life.

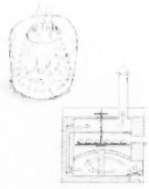

Biomass
Volcanic Gases
PRE-HUMAN IGNITION
Air
Earthquakes
Lightning
Volcanic Sparks
Spontaneous Ignition
Gathered Biomass
Tinder
ABORIGINAL
Human Breath
Perpetual Fire
Friction Igniters
PRE-HUMAN IGNITION
ABORIGINAL
65 MBP: Cretaceous meteors ignite enough of the planet to initiate dinosaur extinction.
38 MBP: First grasses. Will alter the patterns of planetary burning.
12,000 BP: Pottery vessels first found in Japan.
Internal cell combustion. Oxygen increases, making the atmosphere more combustible.
Terrestrial plants adapt to lightning and other natural ignition sources, setting up dry/wet-season biomes. First fossil charcoal (425 MBP).
Homo erectus gradually becomes "keeper of the flame," carrying torches or embers. Uses fire to flush game, keep warm, disperse predators.
Homo sapiens becomes a fire-maker, cooking more varied and more digestible foods.
2B BP
0.4B BP
1.5M BP
800,000 BP

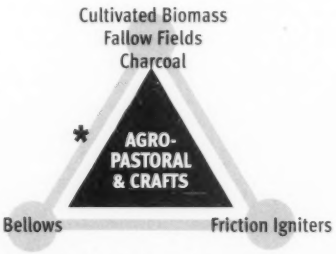
But humans did not set fire by instinct. They were something new; they burned for their own ends. They inscribed lines and fields of fire that laid down a new mosaic; they kindled flame according to new rhythms. It was this regime to which biotas would have to adapt. Anthropogenic fire competed with natural fire, much as domesticated livestock would later compete with wildlife. Flame and all the landscapes fire touched entered the moral universe of humans.

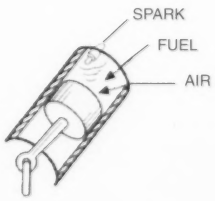
WHERE IT WORKED

Ignition, of course, is not the same as fire. Not every spark took, not every fire could propagate. Human firebrands were most effective in wet/dry biomes, where fire already existed or where the conditions for fire were present but lacked a suitable spark. Thus, people favored fire-prone places and shunned sites hostile to flame. They sought out places with vigorous wet/dry cycles, where they could crack open a biome the way a frost/thaw cycle could crack rock. Into those fissures, people thrust their firesticks. They could patch-burn the landscape without waiting for lightning. The shock was greatest in places like Australia that had the conditions for burning but apparently lacked the regular spark of lightning or volcanoes.

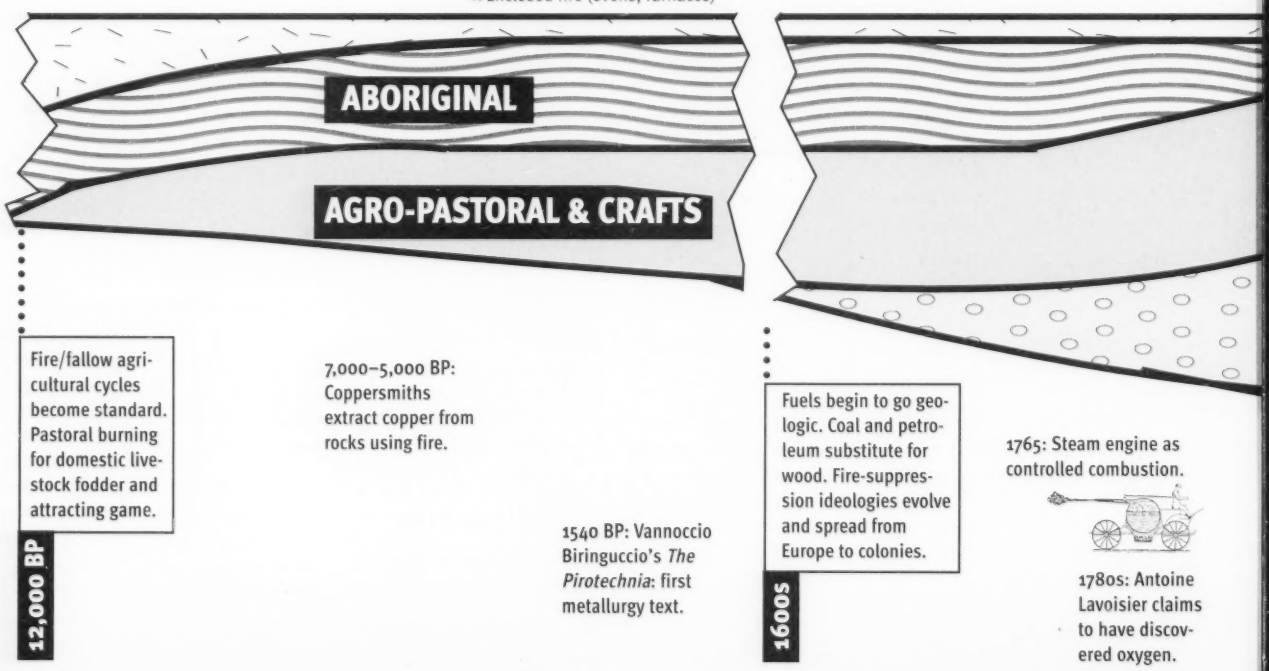
People could further leverage their firepower by hunting and foraging. So intensive can human tweaking of a landscape become that Rhys Jones, scrutinizing aboriginal Australia, coined the term "firestick farming" to describe a scene that was often as intricately manipulated as outright cultivation. Especially important was the disappearance of megafauna (mammoths, giant sloths, mastodons). In fire-prone areas, such beasts competed with fire for biomass. Removing them ratcheted up the amount of fuel available and the spectacular nature of burns. In fire-intolerant areas, however, eliminating those biotic bulldozers allowed the now







*Enclosed fire (ovens, furnaces)


ABORIGINAL
AGRO-PASTORAL & CRAFTS
12,000 BP
Fire/fallow agricultural cycles become standard. Pastoral burning for domestic livestock fodder and attracting game.
7,000–5,000 BP: Coppersmiths extract copper from rocks using fire.
1540 BP: Vannoccio Biringuccio's *The Pirotechnia*: first metallurgy text.
1600s
Fuels begin to go geologic. Coal and petroleum substitute for wood. Fire-suppression ideologies evolve and spread from Europe to colonies.
1765: Steam engine as controlled combustion.
1780s: Antoine Lavoisier claims to have discovered oxygen.

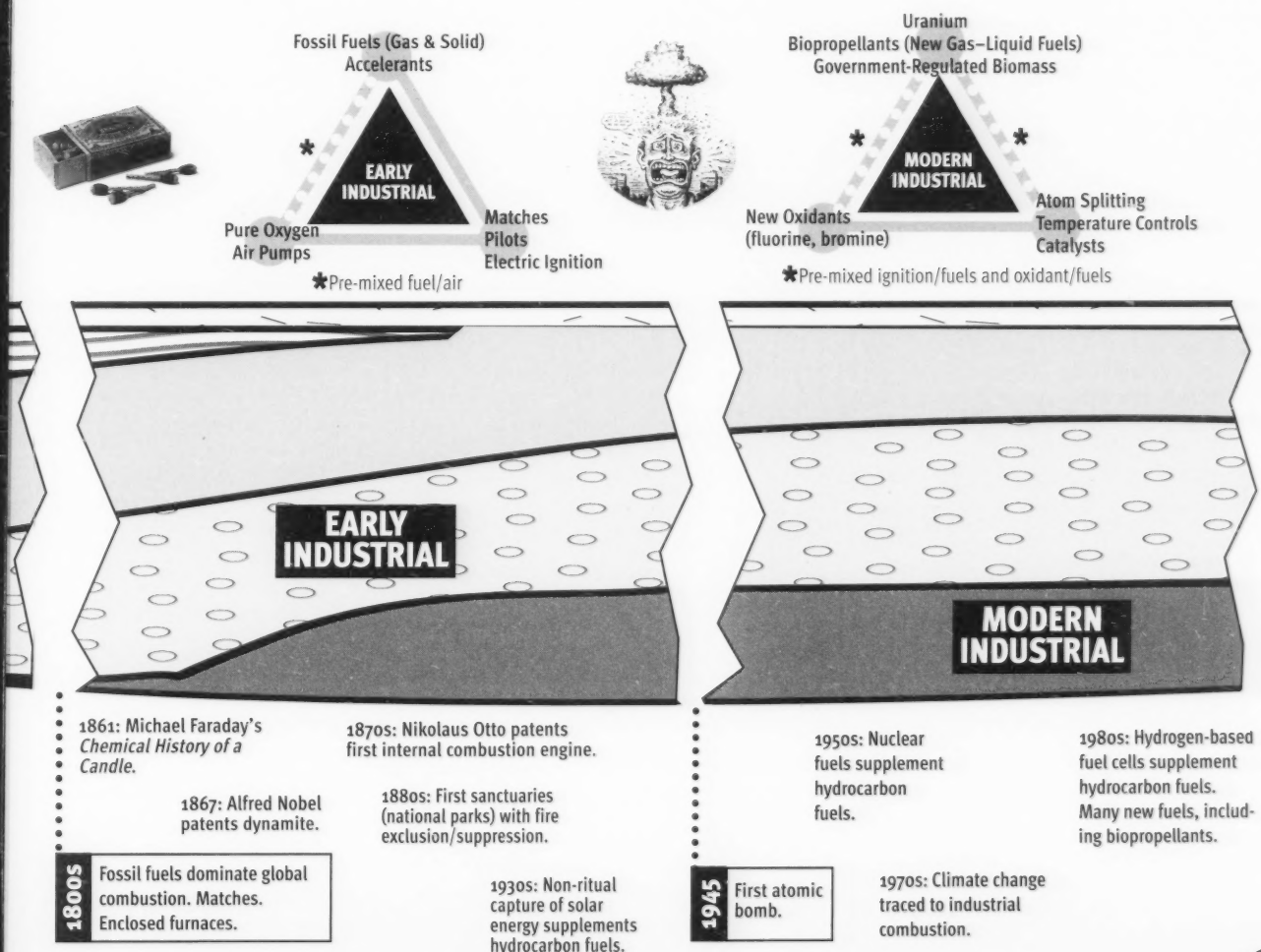
herbivore-free scrub and trees to overwhelm fire. In geographies of weak seasonality and extinct brush-toppling and scrub-girdling browsers, the firestick by itself could not overcome biomass productivity. It became a hammer without a chisel. This scenario likely helps account for the puzzling fact that wet/dry closed-canopy forests exist on the planet.

The fact is, tough limits on anthropogenic fire remained. Mostly, people could only work with what nature presented them by way of weather and fuels. They could not often bring fire where nature would not sustain it. They seized fire-rich sites and those fire voids that lacked only ignition. But they could not break into shade-laden woods empty of dry tinder or hold the frontier against blurred seasons and chronic wetness. The firestick could nudge vast ecosystems, as it did much of Africa, or even wrench whole continents, as it apparently did Australia, but only if it had a suitably arranged fulcrum of tinder.

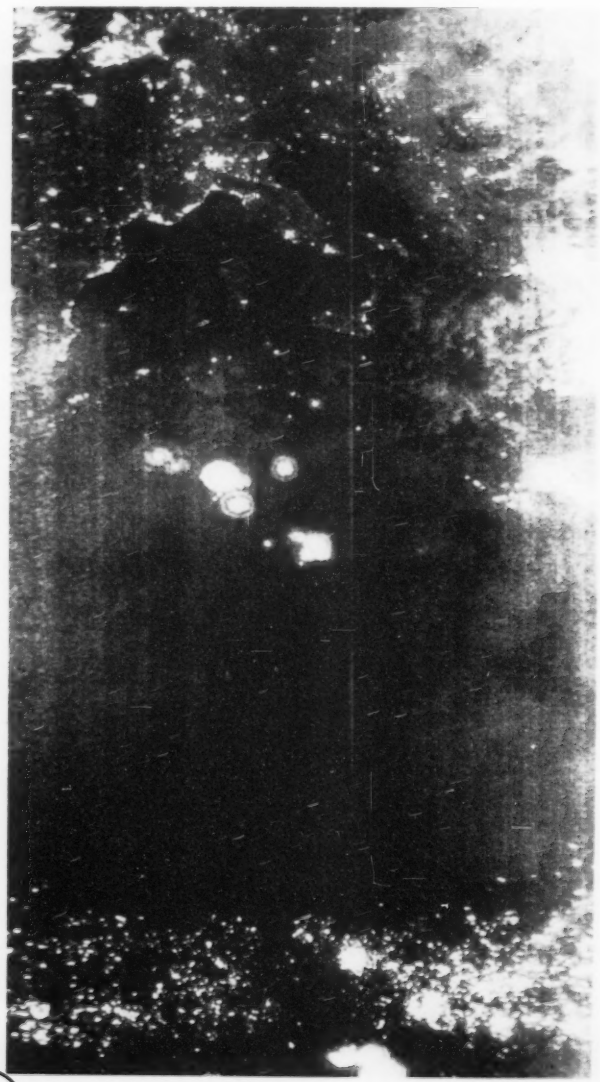
The flame's keepers knew full well both their power and its limits. Their fire starters were stone, wood, bone; their myths often told how fire leaped out of wood or flint when freed from its bondage by people. The possession of fire made them unique, distinct among creatures, yet their firepower itself flowed from nature, which inscrutably gave and withheld.

CULTIVATING FLAME

Until recently, people preferred to live in fire-prone places whose firepower and combustible biomass gave them an advantage. If people couldn't burn, they could do very little. If they could burn, they could not only hunt and forage, they could also plant and herd. While there are systems of agriculture for which fire is irrelevant, that use water instead of flame to disturb, destroy, and fertilize, they are few and do not extend far from floodplains or hillside terraces. (Even these systems often burn



Industrial fire...burns day and night, winter and summer, through wet season and dry, in times of greenup and dormancy. It both ignores and overwhelms the traditional sinks for fire's by-products. The Earth is awash in its effluent....The Big Burn has inspired a Big Dump.



their stubble.) Most agriculture requires fire somewhere in the chain of cultivation. But that requires fuel, and the ability to create fuel is—from a fire-history perspective—the defining feature of agriculture.

The reason for agriculture's flame-reliance lies in basic fire ecology. Flame purges and promotes. For a time, it drives off the local flora and soil microfauna, leaving a cleared space in which some exotic plant can thrive. The creative destructiveness of fire, moreover, shatters the biotic vault in which plants (particularly dead plants) hold critical nutrients. A quick jolt of flame sends nutrients coursing through the site. Shaded sites become open to sunlight, wet sites dry, and the scene more closely resembles those from which the cultigens originated. (Agriculture's hearths are, curiously, almost all fire-prone places.) Then, after the harvest, the local biota close in and the process must begin anew. With farming, caring for fuels joined caring for sparks.

Nonindustrial farming exploits a fire-driven cycle. Either the farm moves through the landscape (as with classic slash-and-burn) or the landscape in effect cycles through the farm (as with rotating fields). Either way, at some point, the system requires the push-pull of fire to turn the ecological crank. Which is to say it demands fresh fuel, such that the cultivator must seek out new sites or bring new fuel to the old site. Farmers could amass combustibles by cutting or by growing them; most easily by abandoning the field to weeds or invading woodlands (and perhaps folding the flock in for a while). But almost any biomass can serve as "fuel" if properly dried: wood, scrub, sod, peat, stubble. If on-site fuel can't be grown, the cultivator must bring in more and spread it over the plot: pine needles, dung, branch wood, or even seaweed. The agronomic name for this fuel is fallow. And fallow, in short, was not burned as waste, but grown or gathered *in order* to be burned.

That was not, however, how urban intellectuals and officials read the scene. Whatever value peasants placed on flame, however critical in practical farming, the clerical classes saw fire through the prism of their habitat, the city. Overall, they detested open burning and distrusted the peasantry who used it. They knew fire in cities. They wanted it only in a furnace or lamp. They saw free-burning flame stirring society, with swiddeners and herders especially always on the move, beyond the grasp of taxes and conscription. They knew fire as danger, as arson and weapon. They interpreted it as an index of social unrest, something that appeared like rats and plague when the prevailing order broke down. They saw fallow as a waste that a society pressed to its population limits could ill afford.

Left: Satellite image of industrial fire and agricultural fire. Extensive dark area is the Sahara with a few large petroleum gas flares (roundish globs), mostly in Libya. Above is Mediterranean with Italy and Sicily outlined. All the white spotting is industrial lighting and combustion. Below the Sahara is speckled ag fire with more petroleum gas flares in Nigeria. Photo from *America's Fires*, by Stephen J. Pyne (see page 64).

Even the great Linnaeus was forced to delete some favorable remarks about swidden and pastoral burning from his published *Sköne* journal and insert in their place a passage celebrating manure. The ideal European landscape was a garden in which every thing, and every body, had its assigned place. Flame belonged in the hearth or in the toolshed. Free-burning fire resided beyond the farm's fenced borders. Ideally, it did not belong at all.

COLONIZING FIRE

Fire, by its nature, puts people and places into motion. Cultivation is a kind of colonization, and agriculture proved a hardy traveler. It needed for its tool kit only something with which to slash and something with which to cast sparks. If the farmer also had livestock, so much the better; hoof and tooth were as powerful as ax and harrow. Flocks and herds replaced the megafauna that had earlier vanished, crunching and chewing the flora into more burnable forms. With ax and livestock as leverage, Mesolithic people could reenter places like central Europe (or at a much later time, Amazonia) from which their Neolithic predecessors had been expelled by climate. Elsewhere they remade aboriginal fire regimes into agricultural ones. Where fire had not previously existed, it now thrived. Where it had previously flourished, it changed character. The domain of fire expanded enormously.

The possible combinations of plants, animals, ax, plow, people, and fire are many. What matters is that all compel a controlled disturbance, and the form that best matches human desires with ecological possibilities is burning. What matters too is that cultivation placed fire ecology even more strenuously into human hands. How fire would behave on Earth became more closely bonded to the will and whim of human life, to a widening gamut of politics, trade, scholarship, war, and legal conceptions of land ownership. None of these had touched natural fire or shaped its regimes. Ideas and institutions proved as significant as storms and cone serotiny. Even today, farming and herding remain the planet's primary cause of open burning.

THE BIG BURN

Agriculture placed vastly more fuels at fire's disposal, but fire could not burn more than what nature could regrow. Limits remained. Nature still determined how much fuel was available. The cultivator could, within bounds, make and break biomass to fashion fuel, but could not evade the cycles of growth and decay that oversaw how much living biomass was available for converting into combustibles. Yet anthropogenic fire was only as powerful as the fuels that fed it. Close tending could smooth the cycles and tighten the links; it could push out the ecological perimeter of burning. Still, it could not breach it, or could do so only fleetingly and at serious costs. Humans could only hope to transcend this profound cycle if they could tap another source of combustibles.

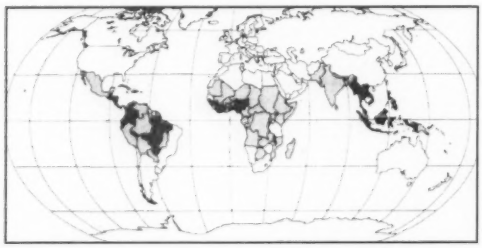
With fossil biomass, they did precisely that. The combustion of coal, gas, and petroleum launched a new epoch in the Earth's fire history, the era of industrial fire—the Big Burn. Combustion now contains geologic time as well as geographic space. More fuel mass burns than before; probably more is burning now than at any time in the Earth's history. Fuel no longer limits combustion as it did. Fossil fuels abound, enough for centuries. The competition between lightning and torch for biomass continues, but both now face a combustion competitor for whom fuel is no longer limiting. Rather, the problem is one of sinks. Industrial fire burns without regard to ecological context. It burns day and night, winter and summer, through wet season and dry, in times of greenup and dormancy. It both ignores and overwhelms the traditional sinks for fire's by-products. The Earth is awash in its effluent, the pollution of combusted fossil biomass. The Big Burn has inspired a Big Dump. Above all, combustion competes for airshed. It may even perturb climate.

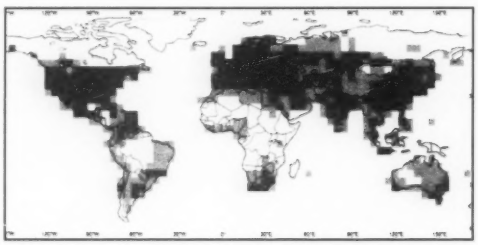
SUBSTITUTION AND SUPPRESSION

The competition takes more direct forms as well. In particular, industrial combustion has aggressively shouldered aside many older pyrotechnologies. Fire had early on bonded with toolmaking and proved as mandatory for technology as it had for manipulating landscapes. If the tended hearth was the core around which a domesticated life and landscape evolved, so cooking served as the model for chemistry. People were able to cook rock for glass, ceramics, metals, lime. They cooked the woods, not only by slashing and burning, but by converting them to potash, tar, pitch, and charcoal. Moreover, technology fed on itself, each tool improving others, mutually refining fuel and flame.

It was in the realm of domestic burning and prime movers that industrial combustion quickly replaced open fire. Steam engines and furnaces could strip a landscape of its fuels; they demanded a deeper, vaster source, which only the geologic past could supply. Yet coal and oil could only be burned meaningfully in specially constructed chambers. And, increasingly, humans sought to control the third leg of fire's triangle, air, as they previously had spark and fuel. Natural gas and

Today the Earth suffers a vast maldistribution of burning....There is too much of the wrong kind of fire and too little of the right. Probably the planet has too much combustion and too little fire.





Top map: Agricultural and forest fires. Darker areas more intense (note the Amazon, West Africa, and Southeast Asia). Total carbon releases range from 1.5–2.5 BTY.

Bottom map: Industrial combustion and cement-plant carbon emissions range from 5.8–6 BTY.

Fire is now neither bioregional nor limited to burning in regions of dry/wet cycles.

From *World Fire* (SEE PAGE 14).

controlled airstreams, as well as electricity from combustion-powered dynamos, swept candles, hearths, and wood-fired stoves aside. A mechanical fauna powered by fast internal combustion replaced a fauna of draft animals that had relied on their own slow combustion that, in turn, depended on the grown fuels of the field. In their built environment, industrial societies have all but extinguished open flame.

The substitutions did not end there, however. Industrial combustion has pursued its biomass-centered competition beyond the city and into the field. Fossil fallow has replaced living fallow, and a flaming front of pesticides, fertilizers, herbicides, and tractor-drawn plows has rendered fallowing irrelevant at all locales with access to industrial products. And the process has gone even further, has pushed even into wildlands, leading to active extinction of open fire. It is here in the wildlands that further problems bubbled up, because fire is as ecologically powerful removed as applied. Fire outside the built environment behaves differently from the way it behaves within it. In fields and woods, flame is not simply a technology, it is an ecological process. An electric range can neatly replace a wood-burning stove, but chain saws and caterpillar tractors do not so replace a crown fire and its biogeochemical complexities.

The Earth is separating into two great combustion realms: one dominated by biomass burning, the other by industrial fire. Industrial fire is competing with human-set open fire as human-set open fire had long done with natural fire. More, the creation of "pristine" wildlands by industrial societies has reduced controlled burning and encouraged more lightning fire. Together, natural fire and industrial fire are squeezing the long-dominant domain of human-abetted open fire.

Even fire control has changed its tactics. Since forever, controlled fire has been the primary defense against runaway wildfire. Protective burning shielded villages and fields and sacred groves; backfires broke the advance of fire fronts. Even while fighting fire, flame remained on the land. But the equipment of industrial fire has replaced hand-set flames as a landscape tool, and firefighters have sought to suppress free-burning by meeting it head to head with the power of internal combustion. Outfitted with vehicles, aircraft, power tools, and chemicals, fire agencies stopped the cycling flames in their tracks, then drove them back. We didn't pursue fire control, we sought fire exclusion. We quit lighting fires and we suppressed those that did occur. Had more of the old regime survived, the forest health crisis on America's public lands would likely not exist.

THE CULTURE OF FIRE

Industrial fire has bonded combustion more closely to culture. Its fire starters are a second-order technology like heated wires and electrical arcs, not natural objects. It burns within enclosed metal and ceramic chambers. It combusts biomass drafted from the geologic rather than the biologic realm.

Industrial fire cannot survive without its human tenders. It would expire, instantly. With industrial fire, we became more than the movers of ecological levers; we became the designers of novel ecosystems that cannot exist without us. More and more, the defining flow of energy through the biosphere is the flow of industrial combustion. More than ever, the mechanics of fire ecology are incomprehensible without including the mechanics of human society. What we know (or don't know, or

wrongly think we know) matters as much as the moisture content of fuels. How we move knowledge through institutions affects fire's ecology as fully as the turning of the seasons. The flow of knowledge is as vital as the flow of nitrogen or phosphorus; the structure of institutions has molded biotas as surely as mountains and rivers and the rhythm of the seasons. Scientific periodicals, professional journals, books, popular magazines, television—all have packaged and shunted the information with which society decides how it proposes to manage fire.

What happens at a fire in California can thus affect fire practices in Georgia. A fire in South Africa can influence fire programs in Australia. The Yellowstone fires of 1988 shut down natural fire programs across the country for a while—and in some instances permanently—and gave pause to fire strategists around the world. Since the world widely regards the United States as a leader, if not the model, for handling the landscapes of industrial fire, decisions reach far beyond America's shores.

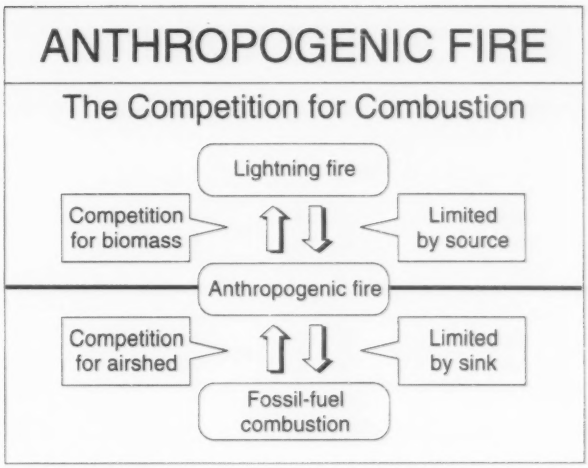
STILL A FIRE PLANET

The geography of Earthly fire remains today neither exclusively natural nor exclusively human. We have not put fire in significant ways into the Sahara, save through the flaring off of natural gas. Nor have we abolished fire from the Siberian taiga. But the geography of fire looks the way it does because of what we have done and not done.

Clearly there have been epochs in which fuels have exceeded fires, in which there has been more biomass than burning. And there are times—the present age, for example—when fire combusts more than what the biosphere grows. The overall fire load of the planet (the amount of yearly combustion) has increased; by how much is difficult to say. In many areas, human agency has meant a change in regime, not in the absolute presence or absence of fire. Only rarely, and then very recently, have humans removed fire from any significant realm.

Today the Earth suffers a vast maldistribution of burning. There are places, mostly in the developing world, that have too much open fire; places, largely in the developed world, with too little; places, along exurban fire frontiers, with volatilely mixed fires. There is too much of the wrong kind of fire and too little of the right. Probably the planet has too much combustion and too little fire.

Ultimately, even the fuel sources must shrink; anthropogenic fire will again have to restrict itself to the cycles of what can be grown. Humanity will have to transcend industrial fire technology, as anthropogenic fire did natural, to fashion sources of power other than controlled combustion. That prospect lies centuries in the future, however. It may not arrive by the end of the third millennium.



From *World Fire* (SEE PAGE 14).

Top: Humans compete with lightning for biomass fuels (trees, grass). They compete over the power to ignite the limited resource: seasonal and climate-controlled fuels.

Bottom: Fuels are not limiting. Now, it's the ability of our airsheds to absorb them ("sink" them into harmlessness) and the ability of plant life to utilize them that are limiting. Nations compete for who can dump more combustion gases without penalty.

STILL KEEPER OF THE FLAME

Fire has meant many things to us, and we, many to fire. Yet throughout the span of centuries, and constantly, amid all our shifting roles—suppressor of lightning fire, promoter of anthropogenic fire, stoker of industrial fire—we have remained the keeper of the planetary flame. Viewed over geologic time, our presence may appear fleeting, but measured by its ecological effects, we have had the impact of a slow collision with an asteroid, throwing embers to all sides, overturning continents, altering climates, wiping out and restoring biotas. Such is the power of fire. And whether or not it was a power we sought, much less deserved, it was a power we gained and one we have never renounced. The seizure of fire was our most daring, our most profound gamble. It made us the biospheric creature we are.

Our prolonged crash into the biosphere has been, above all, a long burn. Beyond the next epoch of geologic time, well after this species expires and another examines its record, we may come to be seen as we have so often seen ourselves: as a flame—destroying, renewing, transmuting. The Earth's greatest epoch of fire will likely coincide with our own. Unquenchable fires will have marked our passage; charcoal will track our progress through history; flame—tended, suppressed, abandoned—will speak uniquely to our identity as creatures of the Earth.

As it should. ❀

Stephen J. Pyne

J.G. Goldammer

Steve Pyne: fifteen years with the North Rim Longshots (a Grand Canyon fire-fighting team); Arizona State University professor burning candles in both history and ecology; today's torchbearer in the blazing lineage of American environmental historians (George Marsh, John Wesley Powell, Carl Sauer); and our long-distance fuel, accelerant, oxidizer, spark, flame, and embers for this issue. I consider him the issue's co-editor.

How does he know so much? You exhaust your intake reading him on the *écobuage* or *essartage* fire/fallow cycle of France, and then on you go to Russia, or the need-fire of Ireland, or fire-stick farming in Australia, or slash-and-burn in Brazil. His fire spread is staggering, especially on the cultural centrality of fire, forestry, and agricultural practices—and also on the transitions from natural to aboriginal to agricultural to industrial to intermixed combustion. Smoking scholarship, burning prose, glowing metaphors.

Especially appealing are Steve's sympathies for those whose daily lives are intimate with open fire: the Smokejumpers, fire/fallow peasants, pastoralists. In them, he finds an antidote for our unbalanced pyrophobia. He looks to the ethical teachings of those who watch fire, think about it, implying that responsibility for such a flamboyant phenomenon (balancing fuel, flame, light and heat, and desire) is a balance between honoring open adventurous "free" flames and tending/caring for more focused utilitarian fire and heat. I couldn't agree more: fire (and water), the great gurus of Gaia.

A Body of Work

Where to start? *America's Fires* (1997; see page 64) is Steve's easiest, short (fifty-four-page) entrée into wildland and forest fires and our changing cultural paradigms. *World Fire* (1995) is the gem of cross-cultural fire comparisons and is the most contemporary in its pursuits. *Vestal Fire* (1997), Steve's most recent, carries a denser wisdom, a melding of the previous eight books. It lays out the Roman origin and spread of the "imperial" European fire ideologies to the neo-Europes (the colonies) of the planet. *Vestal Fire* is a *War and Peace*–scale tome, good for many all-nighters.

Fire in America (1982) was the first in his fire cycle. Though Steve explains its limitations in his new intro (1997), his passionate desire to describe the importance of fire in human history and his closeness to his firefighter experience infuse this volume with a specific pyrophylic, pyromantic intimacy. It sets the tone, his respect for those close to fire's daily workings, for their experiential wisdom versus the academy's mind-bound, isolated ruminations. *Burning Bush* (1991) is about Australia, but even more about Steve's understanding that fire can be a form of cultivation, a fire-stick agriculture. For *Fire on the Rim* (1995), see page 67.

I think you get the idea. This is an unprecedented body of work in the history of American letters and, despite my anticipating that each book will repeat too much of the last, it doesn't! Fire has never had a better friend, benefactor, or keeper of the flame. —PW

Below, left to right: "The conversion of Big Scrub, Gippsland. Note, initially, the heavy understory relative to human figures. Some clearing followed, but settlers mostly ringbarked, killed, and left standing vast domains of eucalyptus. In the final stages, pasture replaces timber; a few groves of ringbarked gums endure, temporarily; and considerable evidence of fire persists." From *Burning Bush*.

“ ...if fire is a point of discord, it is also a means of integration. It remains a focus, literally—its Latin roots meaning “hearth,” and also altar, home, and family—for any human engagement with our surroundings. —World Fire

“ Apart from outright war, almost any form of social unrest, from political protest to economic sabotage to insurrection, has quickly translated into fire. Citizens vote with the torch. —World Fire

“ On the Rim we discussed fire endlessly: there was almost nothing else that mattered. We described our fires’ quirks while hunched over ration coffee on late-night firelines, we compared our fires’ ease and misery when we returned to the fire cache, we sang and cursed our fires at the saloon. They all, each one, had a personality. There were charmed fires and ugly fires, glorious fires and fires that were existentially wretched, fires rich with loose dirt and mean fires that burned amid nothing but roots and rocks. There were fires that hurt, fires that hummed, fires that inspired, fires that infuriated. The character of the fire determined our experience.

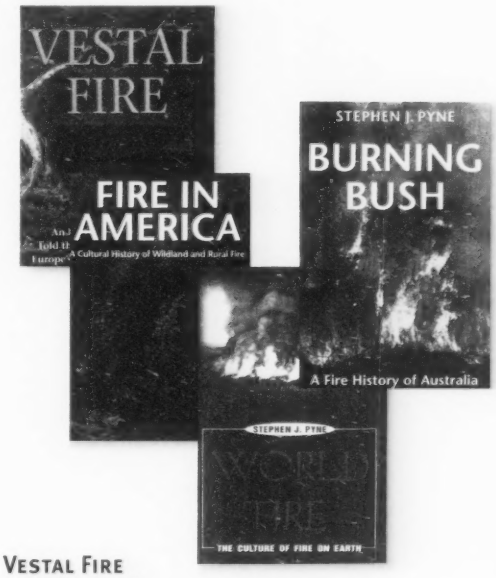
And that was how I would write about historic fires, about fire in toto. —Fire In America

“ But industrialization has gone further. Much as early hominids sought to replace the flame with the torch, and as early agriculturists sought to substitute domesticated burning for wildfire, so modernized societies have striven to replace wildland combustion with industrial combustion. The furnace supercedes the hearth; the power of fire engines, the power of torches. The critical environments are mechanical, literally within machines, and those portions of the atmosphere and biosphere that directly exchange gases with them. Combustion is no longer necessarily even associated with flame. This has rendered the status of anthropogenic burning unclear.... —World Fire

“ The agronomic [fire/fallow] circle would close, only when humans could import energy and materials from outside the prevailing ecosphere. That process began with overseas colonies, which became an outfield to Europe’s infield; but it achieved its apogee when fossil fallows replaced living, and fire was sublimated into machines. Coal and petroleum —extracted from sources far removed from existing ecosystems—poured into the agricultural economy like an infusion of plundered treasure. Applied to fields they brought fertilizers, pesticides, and herbicides; inside internal combustion engines, they rendered obsolete the fodder-demanding horse, donkey, and ox; embedded within a global economy of capital and trade, they shrank the agrarian circle to a vanishing point....this new agriculture, flush with imported biotic bullion, began literally redesigning the rural landscape with the fanaticism of a modernist architect. Banning fallow abolished a good bit of biodiversity and imposed its own ecological costs—an inflationary spiral of excess chemicals that piled up on land, seeped into water, and clouded the air. —Vestal Fire

“ It is not just that fire may be changing world climate, but that the climate of world opinion is compelling a change in our ancient relationship to fire.... —Vestal Fire

“ All the indigenes had fire.... Fire was there, and it remained for Europeans to define new relationships. In Madagascar they redirected it, in Hispanola they suppressed it, in New Zealand they co-opted it, in Indonesia they intensified it, and in Tasmania they exterminated and replaced it. At Easter Island they reclaimed an isle already colonized, degraded, and abandoned. At Jamaica they deconstructed a settled landscape and then repopulated it with new plants, animals, and peoples. Everywhere, smoke by day and flame by night was, in the words of Captain James Cook, “a Certain sign that the Country is inhabited.” Natives set fires that confirmed their presence. Castaways lit signal fires to aid their escape. Fire and people—to find one was to find the other. —Vestal Fire


VESTAL FIRE
FIRE IN AMERICA
A Cultural History of Wildland and Rural Fire
STEPHEN J. PYNE
BURNING BUSH
A Fire History of Australia
STEPHEN J. PYNE
THE CULTURE OF FIRE ON EARTH

Vestal Fire
An Environmental History, Told through Fire, of Europe and Europe’s Encounter with the World

1997; 659 pp. $34.95. University of Washington Press.

Fire in America
A Cultural History of Wildland and Rural Fire

1982; 654 pp. $24.95. University of Washington Press.

Burning Bush
A Fire History of Australia

1991; 520 pp. $24.95. University of Washington Press.

World Fire
The Culture of Fire on Earth
1995; 379 pp. $30. Henry Holt and Company.

Access: Dead Embers *(Suggested by Steve Pyne)*

Fire *Hazel Rossotti. 1993; Oxford University Press.*

Fire in Civilization *Johan Goudsblom. 1992; Allen Lane.*

Fire *John W. Lyons. 1985; Scientific American Library.*

All of these books are out of print or “indefinitely out of stock.” Hazel Rossotti’s was immensely useful to us, as she carefully surveys all the entanglements of fire in human endeavors, with great illustrations. Get this book back in print!

Fire in Civilization has the best summary of fire imagery in Greece and the Bible. John Lyons’s is the best physics-oriented text. Steve Pyne also suggested *The Book of Fire* by William H. Cottrell, Jr. We couldn’t find a copy. —PW

Population & Resources Map *Included with October 1998 issue of* National Geographic. *$5 postpaid. National Geographic Society, PO Box 63001, Tampa, FL 33663. 800/274-6800, 202/857-7000.*

One of several maps on this large-format insert is a composite satellite image showing fires and natural gas flares (as well as the lights of human settlements and fishing fleets) visible from space. —MKS

Burning Mirrors

Snagging Pure Fire from the Rays of the Sun

by John Perlin

The ancient Chinese, Greeks, Incas, and Romans—and no doubt others—discovered very early on that curved mirrors could concentrate the sun's rays onto anything burnable with enough intensity to cause the object to burst into flames in seconds. Because of these instruments' ability to start fires, the ancients, no matter their language, almost universally referred to them as burning mirrors. Both the secular and religious worlds took advantage of these devices to ignite fires, because, as Pliny observed, they "set things alight more easily" than any other way known at the time.

In the ancient Chinese kitchen, for example, a burning mirror was as common as a pot or pan. On sunny days, the son in charge of lighting the family stove took the concave mirror outside and concentrated the sun's rays onto kindling. As soon as the family stove fired up, the women could cook.

In religious rites, those in charge preferred to ignite sacred flames with burning mirrors. The rays of the sun seemed a more spiritual way of creating fire than human hands. Plutarch tells us that when the sacred fires in Greece and Rome were accidently extinguished (for instance, when the sacred lamp was put out at Athens, the temple burned at Delphi by the Medes, or the altar overturned and the fire extinguished in Rome), it was deemed an impiety to re-light the flames from other fires. New fires had to be lit by "drawing the pure and unpolluted flame from sunbeams." These new flames were generally kindled with concave brass mirrors.

Small burning mirror used by 16th- and 17th-century natural scientists. From *A Golden Thread*, John Perlin. 1980 (out of print).

Far across the seas, the Incas of Peru similarly ignited their holy fires with solar energy. Believing themselves the Children of the Sun, they celebrated the summer solstice with great solemnity. Temple virgins concluded the ceremony by flourishing their concave silver mirrors, mounted on gold, gem-encrusted frames. They focused the sun's rays onto cotton wool, which burst into flame. As the solstitial flame had to be lit on that day and no other, if the sun didn't shine the virgins made fire the secular way, rubbing two sticks against each other. But they shook in fear on such occasions, taking it as an evil omen, for, in the words of J. Frazer (*The Golden Bough*), "they said the Sun must be angry with them, since He refused to kindle the flame with His own hand."

Sun-kindled Olympic flame. From Emmanuel Diakakis and Son, Athens.

The Incas, Chinese, and Greeks believed their burning mirrors "collected" fire from the sun. Theophratus, one of the first great naturalists, writing in the 4th century B.C.E., acknowledged that many of his contemporaries "believe they are catching sun rays when making a fire." With the common use of burning mirrors, a good number of people in the ancient world concluded that the flames of the fusion-reactor sun, 93 million miles away, and those chemical, atom-conserving flames here on Earth were one and the same. Explaining the conversion of visible light to flame (and distinguishing chemical from nuclear fire) would take much more than another millennium. But linking solar radiance to warmth, heat, cooking, light, and reverence was joyfully intuitive. ❀

Welcome back John! John wrote one of our most popular cover stories, on solar water heating in LA around 1900 (*CoEvolution Quarterly*, Fall 1971). He's a writer/house-dad with three great books: *A Golden Thread: 2500 Years of Solar Architecture and Technology* (with Ken Butti; out of print); *Forest Journey: The Role of Wood in the Development of Civilization* (1991, Harvard University Press); and *From Space to Earth: The Story of Solar Electricity*, reviewed on page 47. —PW

Biospheric Fire, Fire-Loving Species

For over 400 million years, all creatures on this planet have made their peace with biospheric combustion...or perished. Volcanoes, lightning, sparking rocks in earthquakes, comets, and—rarely—spontaneous combustion from composting fill the box of biospheric matches.

Coevolution reversed some creatures' relationships to fire: fire is not a threat but a necessary component of their lives. Here are a few tales of the pyrophiliacs. —PW

The Need-Fire of a Woodpecker

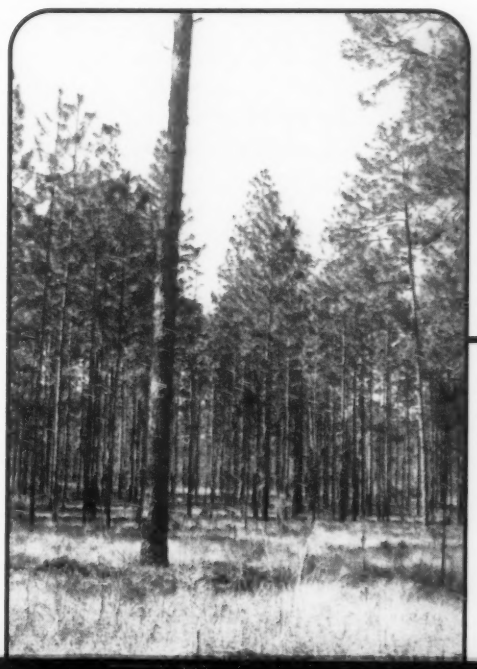
In special holes excavated by humans in Longleaf Pines, a family group of red-cockaded woodpeckers headbob and hammer—doing what they can to survive in their fire-starved home. They miss fire. Fire is their friend, a friend prohibited from these Southeastern forests by pyrophobic humans. They miss the winnowing of fire, which burns out the understory but favors a few large trees that can grow fat and old. They miss the fire-induced fatness that makes the pines voluminous enough for excavation. (It takes more than a year to chip out a home.) They miss old pines that favor red heart fungi, which make excavation of the heartwood easier. And old age favors all kinds of the wood-boring beetles and grubs they prefer to eat.

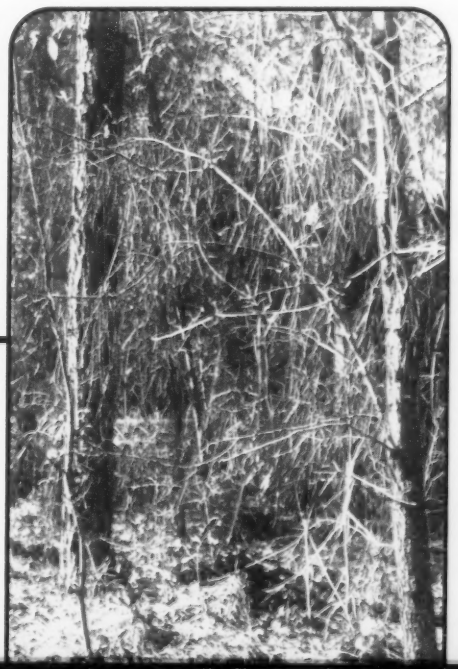
The woodpeckers also miss fire because the understory—unchecked by fire—acts as a ladder to their nests, and rat snakes use this ladder of branches to indulge, whenever possible, in eggs and young. Only burning keeps the understory, and the snakes, at bay. The Longleaf Pines are not averse to fire. They have been shaped to survive periodic burns. Even the infant saplings grow extra-long needles that flame up and snuff out quickly to shelter the bud.

Timbering cannot do what fire does. Fire cuts irregular, not square, patches. Fire rarely over-thins adolescent pines, and doesn't space them in the grids of plantations. The woodpeckers suffer from this change from fire to chainsaw, fire-inspired seeding to plantation nursery seedlings. When, for instance, maiden females leave their family nest each fall, they now wander confused, searching for a lone male: The forest has become fragmented, its architecture chaotic and hard to negotiate.

The Fish and Wildlife Service is trying to help,

KEITH HANSEN



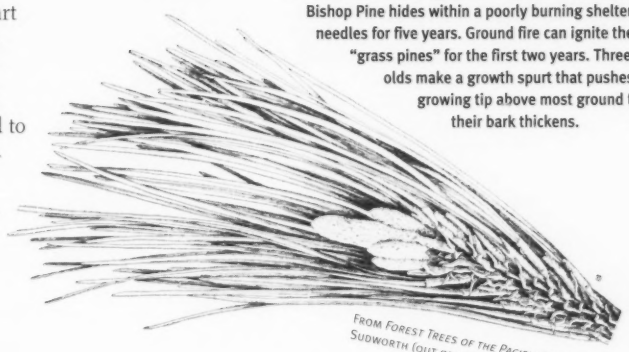


Far left: Longleaf Pine forest with the natural-cycle "evanescent" lower branches that, by falling off, hinder flames from laddering up to the crown.

Near left: Longleaf Pine forest subject to fire suppression. Young trees gather falling pine needles and become the rungs of a combustible ladder that can reach the crowns of their elders, causing catastrophic (total-burn) forest fires.

Photos from *The Ecology of Fire* (see page 64).

even drilling some cavities in trees with no heart rot. But it's the old story: Will hurricanes, catastrophic fires, human-ized forests, and hungry pulp mills bring on the demise of a pyrophylic bird? For the woodpecker lovers who have tried to save this fire/pines/bird complex since the red-cockaded was declared endangered in 1970, there grows now an uncanny silence—no chiseling, no squawks, no crackling of ground fire among the Longleaf Pines.
—PW



Like that of the Longleaf Pine, this protected bud of the Bishop Pine hides within a poorly burning shelter of pine needles for five years. Ground fire can ignite these "grass pines" for the first two years. Three-year-olds make a growth spurt that pushes the growing tip above most ground fires, and their bark thickens.

From *Forest Trees of the Pacific Slope*, George B. Sudworth (out of print).

Kirkland's Warbler

If there is an American totem of open-land wildfire, it is the Kirkland's warbler. It cannot survive without Jack Pine saplings sprouting from flames. Within the elfin sapling forest, the warblers nest and raise their young. The coevolution of Jack Pine and fire is so complete that the cones will not open and drop their seeds without it. If the pines live too long (beyond five or six years, or taller than one foot to five feet tall), the canopy opens below the lowest branches, and the warbler's nest (which is on the ground) becomes exposed, vulnerable to cowbird nest parasites and predatory blue jays. If the ground-fire cycle of wet/dry is broken by fire suppression or aseasonal burning, the community loses its patterning. The ecological crazy quilt of young, tightly clustered pines scattered among open grassland disappears. In short, fire suppression and forest clearing have pushed the music of nature's improvisational quintet—climate/fire/grove-structure/pine/bird—over the threshold to cacophony. There are now fewer than 300 singing males.

Almost every detail of the warbler's life can be traced to the rhythm of fires "cooking" the landscape and maintaining young pines. To remain hidden in the miniature forest, the incubating female never leaves the nest. The male feeds her. The eggs are brooded longer than any other warbler's, so the young will emerge from this tiny amount of protection large and capable. Because of the fire-quilted landscape, the warbler is semi-colonial. Birds returning from winter in the Bahamas have a better chance of finding mates in fire-dispersed patches of pine, if they shared a home range in nestlinghood.

The future symphony will come from a score written by humans, pines, warblers, and fire. It cries out for long-term human care: Until enough pine forest exists to restore open fire, wildlife crews will plant Jack Pines; until cowbirds have been deprived of their parasitoid edge by buffering the habitat, game wardens will trap them; and until naturalists discover what's really happening on the warbler's winter home in the Bahamas, conservationists will have only half the picture. When finally there's enough forest and fire, then the warbler will need only worry about water. It's one of the few birds that bathes in dew. —PW

Tim Manolis

World's Tiniest Infrared Detector

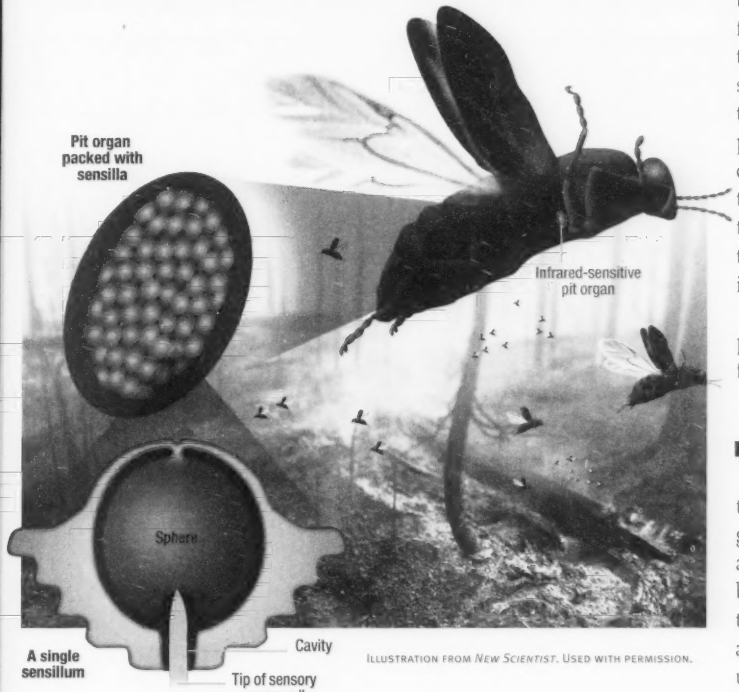


ILLUSTRATION FROM *NEW SCIENTIST*. USED WITH PERMISSION.

Melanophila is a missile, as beetles go; and go it does—with mind-boggling accuracy—to fire. Pine-tree fires, mostly. Equal to the best machine-crafted detectors available to our cops, firefighters, and military, this tiny beetle's system registers the barest trace of smoke and the slightest glimmer of infrared, dispatching *Melanophila* as far as eighty kilometers to pinpoint the source.

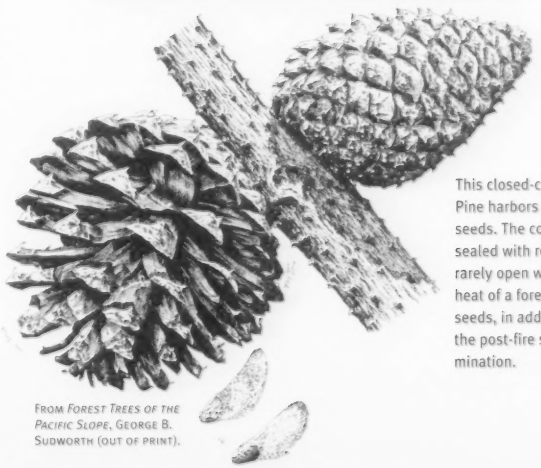
Why? Because a tree in prime health is no place for a woodborer larva. Between its chemical arsenal and its cellular response strategy, a living pine tree vigorously fends off larval intrusion. As far as grubs are concerned, the only good tree is a dead tree. (Or at least a vulnerable one.) Fire's good at that. In the charred bark of a burnt pine, *Melanophila* can lay her eggs with some inchoate confidence that the larvae will survive to chew, grow, and perpetuate the species. So she sniffs for fire.

How does this heat-seeking missilette (just a centimeter long) find its target? The infrared waves emitted by a forest fire produce a distinct signature—and one that cuts through the atmosphere without getting absorbed by water vapor. This wavelength is what *Melanophila* so exquisitely detects. Probably first drawn in the direction of a forest fire by traces of wood smoke registering on its antennae, *Melanophila* lifts its middle legs high in the air and hones in. Under those legs, in great big dimples, are pit organs filled with what may, staggeringly, be the first photomechanical sensors discovered in nature. Each sensor, or sensillum (see diagram), is thought to be triggered by infrared-induced vibration. Literally, pressure from waves of heat—unlike the photochemistry of the eye or the temperature change in the pits of vipers—mechanically stresses the tip of the nerve cell. Multiply this by an average of seventy sensilla per pit organ, and the signal sensitivity increases exponentially.

Melanophila's sensational gift of detection occupies an unparalleled niche in the theater of forest fire. —NP

Black Grouse

By the 1980s, only fifty black grouse, a characteristic species of the Danish heath, remained. The grouse could survive only if the heath endured, and the heath could flourish only if properly burned. Denmark was spending $10 million a year to practice what, for over a millennium, its leading authorities on land usage had condemned as unnecessary, baleful, and destructive. It found that heath reserves often needed fire, that burning was to nature preservation what scrubbing acid-rain-damaged statues in London and cleaning frescoes in Florence were to art preservation. The politics of combustion had been inverted. The smoldering moors had been replaced by smog-drenched factories and city streets, and now it was the misplaced combustion of the metropolis that threatened the heath. —Stephen J. Pyne



This closed-cone Bishop Pine harbors long-lived seeds. The cones are sealed with resin and rarely open without the heat of a forest fire. The seeds, in addition, prefer the post-fire soil for germination.

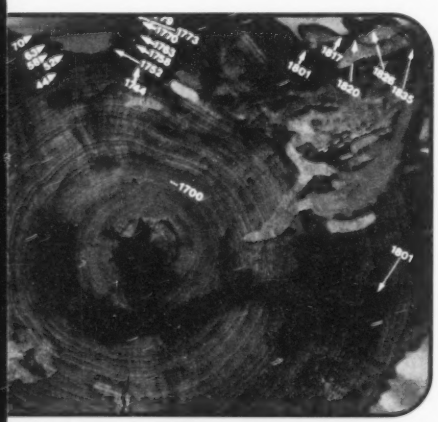
FROM *FOREST TREES OF THE PACIFIC SLOPE*, GEORGE B. SUDWORTH (OUT OF PRINT).

Enlightenment in

Reading Tree Rings Can Be More Informative

Fire histories are reconstructed primarily from cross sections cut from old stumps, logs, and snags. These samples are then finely sanded and cross-dated using a microscope. Top: The last fire scar is from about 1900, in the US. Bottom: Last fire scar is from about 1980, in Mexico. The US record reflects overgrazing and then fire suppression.

Excitement, paid adventure, and travel formed a vortex that sucked me into seasonal fire fighting and spat me out with an M.S. in watershed management. In 1981, I graduated from high school and took my first seasonal fire-fighting job with the US Forest Service, on a Hotshot crew. I remember it for many reasons (for one, I attained legal drinking age that summer). We toiled for weeks, even months, on fires in some of the most remote wilderness areas, forests, and grasslands of the US—the Yukon River, the Everglades, Okefenokee Swamp, near Hawaiian volcanoes, and in most western states. Before I knew it, I had worked for thirteen seasons and looked over hundreds of smoldering "cat faces," ponderosas dripping pitch, and burnt forests with hundreds of years of embedded history turning to char.



PHOTOS COURTESY LABORATORY OF TREE-RING RESEARCH (LTRR).

When I found out that I could actually study fire in forests—in the desert in Tucson, Arizona!—I was ecstatic. The Laboratory of Tree-Ring Research (LTRR) started in 1937, through the hard and brilliant work of Andrew Ellicott Douglass (1867–1962), the founding father of dendrochronology (the science of tree-ring dating). A.E. Douglass initially came to Flagstaff, Arizona in 1894, as an astronomer. While hiking through the forests around Flagstaff, he noted similar annual tree-ring patterns on many stumps. After "reading" many stumps, he speculated that wet years made wide rings and dry years, narrow rings. He hypothesized that tree-ring chronologies might allow him to reconstruct historic sun-spot events; that tree rings could be used as precise time-dating tools (they did!).

Douglass teamed up with archeologists on the eminent National Geographic Beam Expedition to cross-date wood samples during the excavation of the Aztec and Pueblo Bonita ruins. For the first time, a scientific team successfully determined the ages and time of construction of prehistoric structures. Douglass's ingenious discovery radically changed our views of history. In Chaco Canyon, New Mexico, for instance, Julio Betancourt and others traced the construction of buildings by coring ancient piñon beams. They showed that, as time went on, trees appeared to get scarcer and scarcer, and more logs were recycled for new buildings, until Chaco Canyon was finally abandoned.

LTRR can reconstruct climate and fire histories from about 200 to 500 years back from pines and oaks, or even 1,000 years, from giant Sequoias in the Sierra Nevada. Using tree cores and polished stump slabs, the Lab can fine-tune the accuracy of carbon-14 dating techniques, and reconstruct cultural patterns of forest land uses. It is the world's largest wooden library of fire histories reconstructed from fire-scarred trees.

Long-lived conifers are often scarred, but not always killed, by surface fires of needles and grasses. These pine trees respond to fire scarring by infusing pitch (volatile terpenes) into the scarred areas, or cat faces. The pitch makes the pines even more susceptible to burning and scarring by subsequent (even low-intensity) fires.

El Niño Fuels, La Niña Ignites

Tree rings have provided solid evidence of the teleconnection between global El Niño events and inland fire patterns. Throughout the US/Mexico borderlands, tree rings display a pattern of extensive low-intensity surface fires encompassing most pine and oak forests and lower desert grasslands. These regional fire events are strongly associated with El Niño. During El Niño years, more rain falls and fine fuels like grass accumulate. When El Niño is replaced by La Niña, the dry, fuel-laden communities become the fuels for strong and widespread fires.

The geography of fire intensity and frequency, as well as the human role in creating the pattern, is

Burnt Forests

than Reading Books

by Mark Kaib

Right: A cat face, the part of a tree burned by a fire or fires. Maybe the name comes from the glowing ember eyes that remain after the fire has swept through.

PHOTO COURTESY LTRR.

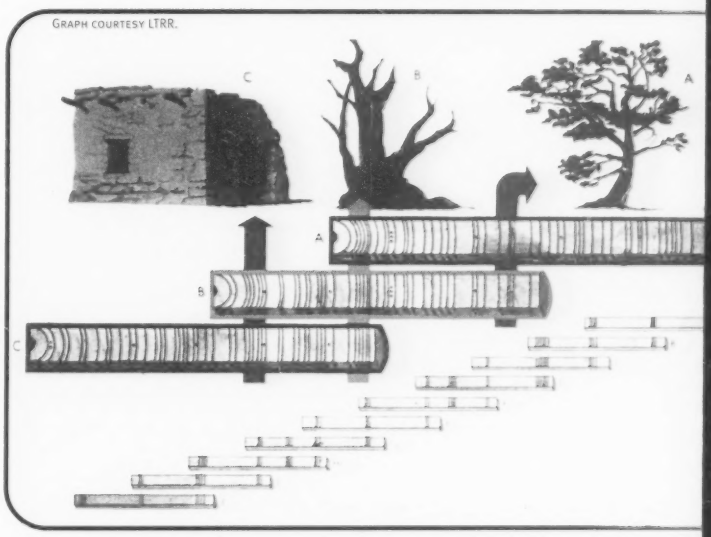
reflected in tree-ring records. No other historic record can give us this sense of history. For instance, LTRR has found that widespread surface fires ceased in the late 1800s with the advent of heavy livestock grazing and Euro-American settlements. Reduced fuels (from cattle grazing away grass) and fragmented landscapes (with new firebreaks such as roads, towns, and railroads) impaired the ignition and spread of fire. The regular pattern of fires abruptly stopped with droughts and overgrazing in the 1880s and 1890s, and a more chaotic Euro-American pattern appeared.

The ability of fire-scar dating to reveal year-by-year patterns for hundreds of years can help fire managers reintroduce prescribed fire with a much better understanding of when and how often prescribed fires should occur. We confirmed, for instance, that the pre-1880 fires in the Southwest occurred in the lightning season, at the end of the dry fore-summer, before the monsoonal rains. Even when Native Americans set fires, they usually set them in the same season as nature.

Until recently, the Forest Service had no idea how often fire burned, for instance, through the oak/pine woodlands and some of the conifer forests. The best guesses, made from newspaper accounts, said that forest fires occurred every seven to ten years; and the newspapers rarely told you what kind of trees went up in flames. LTRR's extensive tree-ring records from the Rincon Mountains just east of Tucson, dating back into the 1600s, show that before the 1880s, oak/pine woodland fires occurred every four to eight years. In some ecological communities, prescribed burns should be more frequent.

My work has led me into Mexico. As opposed to those in the US, fire patterns in some remote forests of northern Mexico remained unaltered into the mid-to-late 20th century. Tree rings suggest that lightning and El Niño fuel cycles continued to sustain frequent low-intensity fires—contrary to the US pattern, where fuel loads increased from fire suppression and led to longer fire intervals followed by severe or catastrophic fires. It appears that neither Native American nor Mexican ranch and farm burning, nor any organized fire suppression, took place in these remote areas. Amazingly, some of these forests in northern Mexico are in a less-altered or more pristine wilderness condition than forests in the neighboring US, despite American pro-wilderness movements. Mexican forests should be better recognized for their ecological integrity and regional diversity.

GRAPH COURTESY LTRR.



Above: We can trace history from tree rings by backtracking from a known live tree (A) and matching patterns with dead trees (B) and even cross beams (C). Note how tree rings at the arrows line up. Closely spaced rings reflect droughts.

In short, trees are a great library of data, a great home of information on history, climate, ecological change and patterns, and human attitudes toward nature. They "store" fires. Maybe tree rings can teach us to respect their long-term knowledge, and through them to live a more harmonious life with forests. ❀

LABORATORY OF TREE-RING RESEARCH

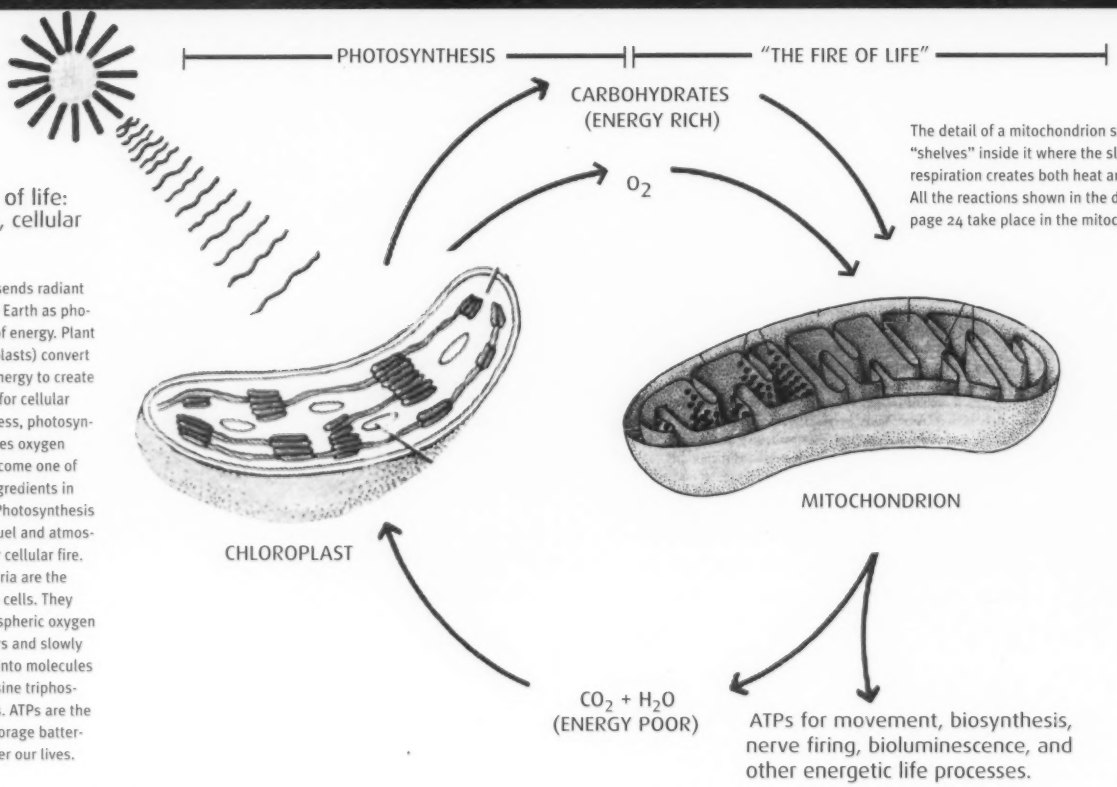
The University of Arizona, West Stadium (Building 58), Tucson, AZ 85721. 520/621 1608, www.LTRR.Arizona.edu.

See the LTRR Web site for more detailed descriptions, references, links, tools, and software. Learn how to cross-date tree rings at http://tree.LTRR.Arizona.edu/skeletonplot/introcrossdate.htm.

The Fires of Life

How Cells "Combust" Metabolic Fuels Invisibly, Internally, and Biospherically

by Harold J. Morowitz



The detail of a mitochondrion shows the "shelves" inside it where the slow burn of respiration creates both heat and ATPs. All the reactions shown in the diagram on page 24 take place in the mitochondria.

The fires of life: solar fire, cellular fire.

Solar fire sends radiant energy to the Earth as photon-packets of energy. Plant cells (chloroplasts) convert the photon-energy to create sugars (fuel) for cellular fire. The process, photosynthesis, releases oxygen which will become one of the crucial ingredients in cellular fire. Photosynthesis makes both fuel and atmospheric gas for cellular fire.

Mitochondria are the retorts within cells. They mix the atmospheric oxygen and the sugars and slowly "burn" them into molecules called adenosine triphosphates—ATPs. ATPs are the biological "storage batteries" that power our lives.

The grand physical description of life on a global scale is "energy flows and matter cycles." Energy from very energetic solar photons enters the biosphere as visible light and exits as heat that radiates back into the deep cold of outer space. Between the energy's coming and going, the photons captured by photosynthesis power the intermediate processes that organize the structures of life and generate the fire of life.

Photosynthesis generates biofuels in solar-powered cellular factories. During photosynthesis, the captured photons split water into hydrogen and oxygen. The oxygen is released into the air to join the pool of atmospheric oxygen gas, while the hydrogen combines with carbon dioxide to give rise to organic molecules like edible sugars.

Subsequent metabolism uses these organic molecules for structure building, and as fuel for doing work. During metabolism, biomolecules recombine with oxygen to form water and carbon dioxide, while the energy created does all manner of biological work and is finally released as heat. This slow combustion of living molecules—energizing the performance of work and the release of heat—is the fire of life.

In this sense, all fire is the fire of life, for the oxygen that combusts with wood and fossil fuels has also been made by life during photosynthesis. Energy flows and matter cycles: The photons from the fiery sun—captured by plants, algae, and cyanobacteria—store solar energy as hydrogen compounds and release oxygen, which becomes

part of the atmosphere. Oxygen made by life is the energizer of life, for fast or slow combustion.

Fast versus Slow Burns

In each living cell is a series of enzymes that govern its chemistry. These remarkable molecules guide reactions, allowing a slow, low-temperature "burning" that converts the stored energy of foodstuffs into chemical potential with the least possible energy loss as heat.

In an ordinary steam engine, fire from wood, coal, or oil converts all the stored chemical energy of the fuel to ash and heat. A small amount of the heat converts water to steam, and the engine does its work. However, most of the heat energy is dissipated; steam engines are not very efficient, and indeed may cause excessive local heating or thermal pollution. (In a typical car engine, 25 percent of the combustion energy is turned into useful work; 75 percent is lost as heat.)

In a cellular system, much less of the energy is thermalized; a substantial amount is stored as chemical potential in molecules of adenosine triphosphate (ATP). These molecules are the biological batteries that supply the energy for the mechanical work of muscles, the electrical work of nerves, and the chemical work of synthesizing new cells. In a cell—significantly more efficient than the car—40 percent of the combustion energy is conserved, and 60 percent lost as heat.

Firewood versus Bread

Let's look at the difference between the hot fire of a burning wood pile and the slow fire "burning" within us when we eat a piece of bread. Both the wood and the bread are complex molecules (polymers) of sugars, so both reactions can be described as:

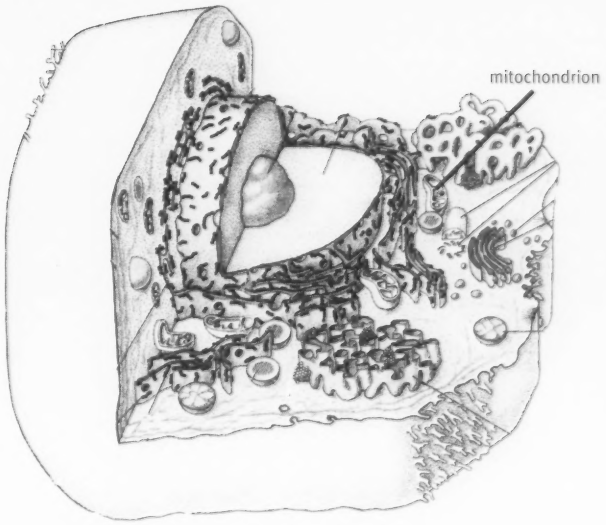
Sugars + Oxygen yields Carbon Dioxide + Water + Energy

or, more precisely:

$C_6H_{10}O_5 + 6O_2$ yields $6CO_2 + 5H_2O$ + Energy.

In the case of the wood fire, the energy is entirely released in the form of heat. In the case of the metabolism of bread, an appreciable fraction of the released energy ends up in the chemical potential of ATP, whence it can go on to do the work of life.

In the wood fire, the heated wood combines directly and somewhat randomly with the oxygen in the air, to yield a wide variety of breakdown products (such as soot), all of which ultimately go all the way to carbon dioxide and water. The energy emerges as heat—the kinetic energy of the moving atoms and molecules. Because the wood's polymers are being destroyed by heat at high temperatures, we see flames.



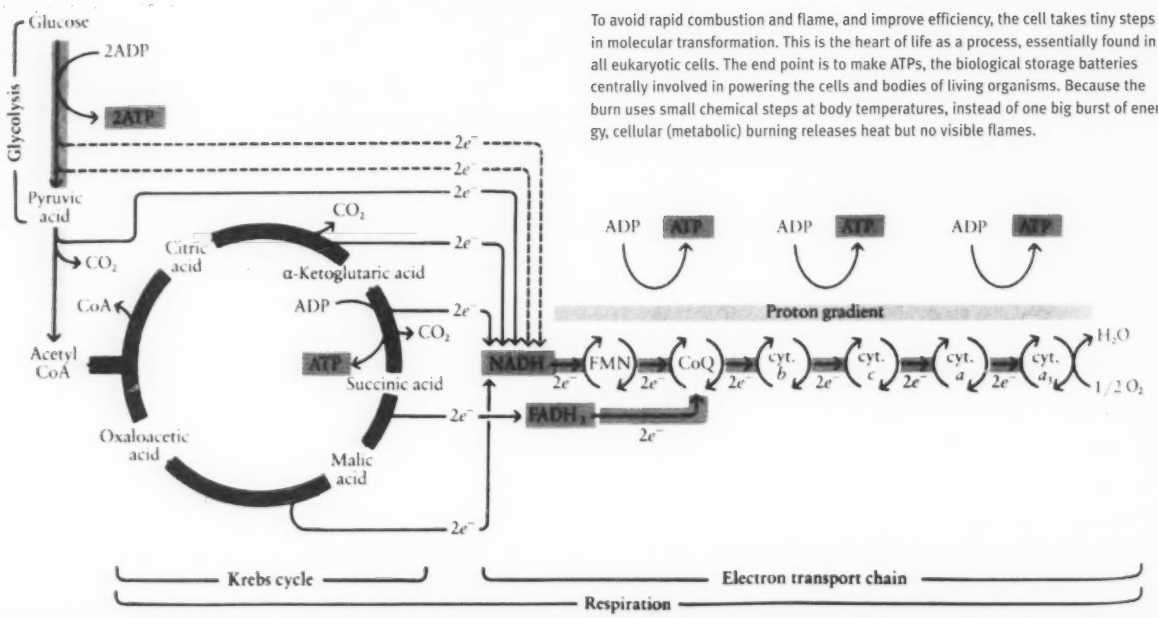
An animal cell can be pictured as a tiny furnace with fuels going in, wastes ("biochemical ash") going out, and chemical messages adjusting the cellular slow burn. Rather than a simple flaming burn, the cell intricately orchestrates molecular transformations at body temperature that accomplish similar ends more efficiently. In a sense, the cell fire has never been duplicated. Human-inspired heat-based transformations, from cooking to organic chemistry, still learn subtleties from cells.

The mitochondria are the organelles that focus cellular oxidation ("fire"). All other parts play roles in directing molecular traffic within the cell, ridding the cell of wastes or constructing new molecules with the energy provided by mitochondrial ATPs.

The bread, of course, must enter the cells in order to be metabolized. Pieces of bread cannot pass through the cell membrane, but sugar molecules can. So step one is the conversion of bread to sugar, beginning with the action of the enzyme amylase in the saliva. Enzymes are specific-cell catalysts, meaning they can speed up designated cell reactions without being altered themselves. (An approximate metaphor would be an ax that splits wood into pieces without itself changing.) Because a cell operates at low temperature, the reactions that take place are determined by which enzymes are present.

The secret of slow combustion is that the complex network of chemicals in the cell breaks up the combustion process into a large number of elementary steps, each of which involves relatively small energy changes. Small incremental energy change permits the cell to operate nearer to equilibrium, and permits a higher conversion of energy into chemical potential. (Contrast this to wood fire, which takes just one or two steps to violently raise the temperature in one big energy change.)

Starting with one sugar glucose molecule, it takes eleven steps and eight enzymes to bring us to two molecules of acetic acid. Each acid then enters a cell cycle where it is completely "burned"



To avoid rapid combustion and flame, and improve efficiency, the cell takes tiny steps in molecular transformation. This is the heart of life as a process, essentially found in all eukaryotic cells. The end point is to make ATPs, the biological storage batteries centrally involved in powering the cells and bodies of living organisms. Because the burn uses small chemical steps at body temperatures, instead of one big burst of energy, cellular (metabolic) burning releases heat but no visible flames.

(oxidized) to carbon dioxide and a spectacular product of energy-rich, hydrogen-rich molecules. The carbon dioxide is released to the environment and the molecules of the energy-rich ATP are made available to the cell.

At this stage, the hydrogen-rich compounds go through still another series of ten reactions and enzymes, ultimately combining the hydrogen with oxygen to form water. The sugar has now been completely combusted to carbon dioxide and water. The energy from the final oxidation is used to charge up a proton storage cell. This stored energy is used to make many more ATPs, the ubiquitous energy-transfer molecules. So the slow burning of sugar in cells converts a good deal of the energy of the reaction into a form to do biological work.

Without the Inner Fire, No Life

The central reactions of cellular metabolism go back some four billion years, to all life's universal ancestor—which originally operated in the absence of oxygen. The ancestor's energy came from chemicals bubbling up from the magma just below the surface of the earth. Then, about two billion years ago, photosynthetic organisms started to build up our rich oxygen atmosphere. At this point some cells learned how to use the oxygen for energy, employing familiar chemical pathways but running them in the opposite direction. Invisible, internal, cellular fire entered the world. As the biosphere's oxygen concentration increased, the flash point lowered and ordinary, visible biomass fire appeared. After photosynthesis took over as the primary energy source for biomass fuels, all earthly combustion became a gift from the fiery sun. And so it has been for the last two billion years.

The earth, water, air, and fire of the ancients are the lithosphere, hydrosphere, atmosphere, and biosphere of today's geochemists. Without the last of these, there would be no fire. ❀

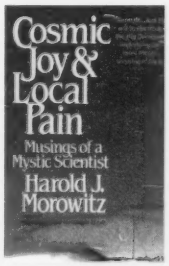
Our review of Harold's *Energy Flow in Biology* in the early 1970s persuaded its academic publisher to print thousands more copies of the book. Harold's been the clearest voice on bioenergetics in the US. Read *Mayonnaise and the Origin of Life* or *Cosmic Joy and Local Pain* (both from Ox Bow Press; see below), sweet essays on humpback whales, the tao of science, molecular bacteria, Spinoza's view of God, and the noosphere of Pierre Teilhard de Chardin. —PW

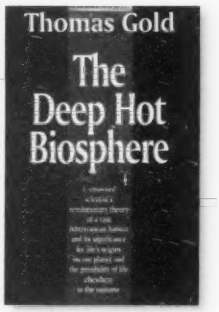
Metabolic Access

COSMIC JOY & LOCAL PAIN
Musings of a Mystic Scientist
Harold J. Morowitz. 1987; 321 pp. $18.95 ($23.95 postpaid). Ox Bow Press, PO Box 4045, Woodbridge, CT 06525. 203/387-5900, oxbow@gte.net.

METABOLIC PATHWAYS CHART
$3.75 (about $12 postpaid). Sigma-Aldrich Chemical (product #M3782), PO Box 14508, St. Louis, MO 63178. 800/521-8956, www.sigma.sial.com.

The only (and amazingly!) comprehensive flow chart of the fire of life.





The Deep Hot Biosphere

Thomas Gold. 1999; 235 pp. $27. Copernicus Books.

"Surface chauvinism," proclaims Thomas Gold, is why we've developed such a lopsided view of life on Earth. Whales and redwood trees we can relate to. Below that, as we plunge into a new place, Earth's bowels—home of Gold's proposed "deep hot biosphere"—our observational intensity rapidly declines.

In *The Deep Hot Biosphere*, Gold marries a "deep-earth gas" theory he proposed in 1977 with a "deep hot biosphere" theory he first published in 1992. The synthesis contains three heated revisions of Earth history. First, the origin of petroleum is nonbiological! And petroleum pervades much of the Earth's upper crust, not just the sedimentary rocks where petroleum companies hunt for riches. Second, life on the planet originated not in shallow sea waters but in deep sea vents, and today the entire crust of the Earth, to a depth of several miles, is populated by living creatures—the great bulk of Earthly life. Third, the non-biological hydrocarbons continue to leak up and to replenish oil fields. Our supply is not limited to the next fifty years. So with one sweeping hypothesis, Gold single-handedly proposes a new location and mechanism for life's origin, and claims we may continue to mine petroleum well beyond its now-predicted extinction.

Is there *unequivocal* evidence for a deep hot biosphere? By 1990, holes as deep as 6.7 kilometers (4.2 miles) had been drilled at Siljan (Sweden) using contamination-free drilling techniques. Definite quantities of volatile petroleum gas and light oils were recovered, along with a strange black putty-like fluid that carried a strong, objectionable odor and was thick with microscopic particles of magnetite. Two kinds of living thermophylic iron-reducing bacteria (which extract oxygen from hematite, changing it to magnetite) were cultured from the sludge. A later pump test of the well produced twelve tons of "normal-looking" crude oil mixed with fifteen tons of fine magnetite particles. This appears to be conclusive proof that there is life very deep within the Earth. How much, is as yet unknown.

The standard story about petroleum formation is that the hydrocarbons originated in the biological debris of marine algae, were further processed by microbially aided warm-temperature distillation, and ultimately settled as sediment beneath the waters of shallow seas or lakes. The giant Arabian and Texas Gulf Coast oil fields are found in youthful marine sediments and are perfect examples of where Cretaceous trash oil ought to be found. However, Gold reminds us, no one has ever converted cellular trash into petroleum hydrocarbons in the laboratory; and sedimentary rocks may simply be locations with more empty spaces than igneous bedrock.

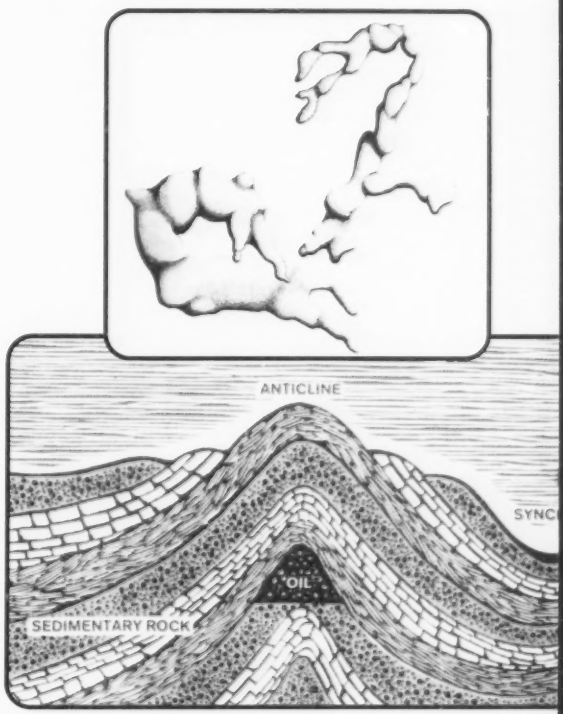
Gold argues that hydrocarbons (HCs) can be "primordial" (dating to the solar system's origin). Light HCs are found on several other planetary bodies and moons. Saturn's Triton seems especially well endowed with methane, ethane, and other HCs, presumably nonbiological in origin. One class of Earthly meteorites (carbonaceous chondrites) contains a rich assortment of tarry, carbon-based polymers. Gold believes these primordial hydrocarbons are the unrecognized ingredient of today's petroleum reserves, and that they continue to bubble up from the Earth's depths.

He adds a third ingredient to the combo of primordial hydrocarbons and Cretaceous trash: a kingdom of thermophylic microbes (the bacteria-like Archaea) living in the upper ten kilometers of the crust. He argues that there is a distinctive fingerprint in oil (haponoids) which can only come from Archaea. Before the primordial hydrocarbons rose near the surface, the Archaea worked them over. Says Gold: "Liquid petroleum and its volatiles are not biology that has been reworked by geology, but *geology that has been reworked by biology*." Gold is not alone in his new recipe for petroleum. In 1963, pioneer petro-chemist Robert Robinson wrote, "Petroleum...[seems to be] a primordial hydrocarbon mixture into which bio-products have been added."

If he is to be convincing, Gold must prove an interpretation of Earth history that most geoscientists do not accept—that the early planet never heated up so much that the core wholly melted (that action would likely have purged HCs upwards, leaving nothing in the deep). In order to prove that petroleum rose from the deep, rather than sank from surface swamps, he must prove that the core's early radioactive furnace was not as hot as is now believed.

Gold also takes on the origin of coal from "swamps"—glibly assumed in most textbooks. A number of uneasy questions (high purity, unexplained petroleum-like chemistry) give Gold reason to seek an alternate, nonorganic explanation. The question is open: Scientists cannot reconstruct the transformation of a swamp into coal any more than they can a swamp into petroleum. Unfortunately, Gold does not review critical evidence for alternate viewpoints, particularly the distribution of coal beds.

Though not all of his arguments work, the key points—the presence of nonbiological hydrocarbons, and a mother, deep hot biosphere—seem in Gold's favor. Just perhaps, we've not yet attended to the major part of the planet's biosphere. —Robert Scarborough



"With respect to the petroleum paradox, the unrecognized assumption on both sides of the debate was an unquestioned belief that life can exist only *at the surface of the earth*. None of us had considered that a large amount of microbiology could exist *within the earth's crust*, down to the deepest levels to which we can drill.

That assumption is a vestige of what I've dubbed surface chauvinism, the belief that life is only a surface phenomenon. If we can strip away that assumption, we can entertain the proposition that the biological molecules present in crude oil are not vestiges of surface life long dead, buried, and partially transformed. Rather they are evidence of a thriving community of microbes living out their lives at depth, feasting on hydrocarbons of a deep, abiogenic origin. Once free from the preconceptions, we can open our eyes to the existence of a deep hot biosphere.

Top: An archaeobacterium that survives with low oxygen and great acidity, similar to creatures believed to dwell in the deep hot biosphere. Bottom: Old geology placed oil in pockets in sedimentary rock near the surface. Author Gold suggests a deeper and primordial origin for petroleum.

Soul Fire

"What do you desire to stay on this side? ...As soon as I was within I would have flung myself into molten glass to cool me, so immeasurable there was the burning".... Dante enters the Fire; the four angels of Inspiration appear in the flames. Engraving by William Blake.

Soul articles:
Need-Fire, p. 27;
Uma and Shiva, p. 34;
The Hysteria Fire, p. 53;
Burning Libraries, p. 56;
Bright and Warming Flames, p. 57;
Gaston Bachelard review, p. 37.

Fire is a preeminent way for humans to kindle compassion, extract golden hearts from evil bedrock, and act out personal and community conflagrations. Hearth or holocaust. Devotion or devilry. Healing sweat lodges or autos-da-fé. Pyro-chrysanthemums exploding in celebration or witchy ignitions of effigies and real flesh.

Fire is our closest analog to spirit, its spectacular metaphor of ecstasy, sex, and enlightenment. We have even subdivided our bodies into a fire regime. Belly fire stokes good digestion and desire. "Come on baby light my fire." Head fire burns brightly with intellect and religious reverie. Fire-arms gesticulate and inflame fury in speeches, swords, arson, and defiance.

And every human culture stares at open flames as meta-maps of life/death impermanence. By the heat of cellular metabolism and soul fire is a child born, and, like fire itself, must eventually die. How it burns its way through existence is the reverie of the flame's edge—the wavering edge where colors turn to spirit. Is there a paradise or a return after ashes?

All faiths feature sacred specialists who move inner body heat outward to mingle with the fires of community, biosphere, and cosmos (page 77). In some, their invisible heat becomes a miraculous outer light. Halos glow about these more angelic folk. Other fire practioners—especially Asiatic shamans—travel the life/death sides of the fire front: sometimes in smoldering songs and sometimes swallowing hot coals or torches or walking through fire with no ifs, ands, or buts.

Fire oscillates between the actual and the possible; stitching soul to neighborhhood—or, in the case of Shell oil executives, self to global tending of the petro-flame. Locally, drink firewater, then fight or philosophize. Deodorize the home with incense then invite over friends and divinities; burn the weeds of the fields; join others healing in a steam bath; place a loved one in the crematorium. These are the place-based fire rituals, reaffirming the fire circle as communal banquet.

Be assured, a change in attitude toward fire signals a change, usually irreversible, in community direction. Abraham was hardly sentimental when he consented to sacrifice his son to Yahweh, when he built the altar and gathered the wood. With Abraham's act, the Israelites defined themselves. With a new fire-focused foundation, they rejected human fire sacrifice to baals and Moloch; and turned to a God who allowed non-human meat, and finally candles, to substitute for burning one's first-born son. Altering a community's attitude toward faith and fire rendered their devotion less cruel. Or, at Pentecost, the Holy Spirit appeared as flames to the disciples; or God appeared to Moses in the burning bush.

Most of us prefer small fires to apocalyptic. Lady Wilde tells the story in Ireland (opposite page). First, all households extinguished existing embers and the whole community met to start a giant "need-fire." From it, torches went home to kindle the year's new fire. The need-fire was the central celebration of shared community. The need was not fire. Everyone had operational fireplaces. The need was to sow new seeds with collective embers. Everyone—chickens, cows, citizens—literally passed through fire to purify themselves and to re-invigorate the community (including its sex and marriages).

Today's moral tales of fire entangle: the Goliaths of internal combustion engines, and the Davids yearning for new lifeways that will not sacrifice our children on the altars of nuclear and fossil fuels; the Saint Francises finding sanctuaries from the fire suppressors for fire-loving species; everyone mutually re-working fossilized gender-locked attitudes toward who tends the hearth and who is the flame thrower. —PW

Need-Fire

Kindling New Fire; the Basic Rite of Community Renewal

by Stephen J. Pyne

PHOTOS FROM *FIREWALK: THE PSYCHOLOGY OF PHYSICAL IMMUNITY*, BY JONATHAN STERNFIELD. 1992; 236 PP. $12.95. BERKSHIRE HOUSE.

Above: Not so good for the gander. A 1937 firewalk in Carshalton, England, tested the mettle (and soles) of three Brits...who were burned in the attempt. Their leader, an East Indian firewalker and magician, walked the (1,067°F) coals twice without harm.

Above left: Firewalker Peggy Dylan.

ADAPTED FROM *VESTAL FIRE*, BY STEPHEN J. PYNE (SEE PAGE 14).

The ceremonial core of "need-fire" was to kindle the new fire to purify and fertilize the community, and to prolong these benefits by using the need-fire to rekindle the hearth fires. From the need-fire the participants ignited a great bonfire. Into it they sometimes threw effigies of witches, or burned animals like cattle or witch-identified creatures like cats. ("Bonfire" derives from bone-fire.) Through the bonfire's smoke, and over its ebbing flames or coals, they passed their flocks—cattle stricken by murrain, most commonly, but also pigs, geese, and horses in set order. Then they passed through themselves. Next they carried the flame and smoke with torches through the countryside; their fields, orchards, and pastures. The ashes were sometimes scattered over the ground, and sometimes pressed over their faces. They carried the embers or tapers to their homes to re-ignite the hearth, and kept the extinguished brand in the house as a talisman against lightning, wildfire, and witchcraft.

Lady Wilde provides a remarkably full account of the Midsummer's fire as it persisted in nineteenth-century Ireland.

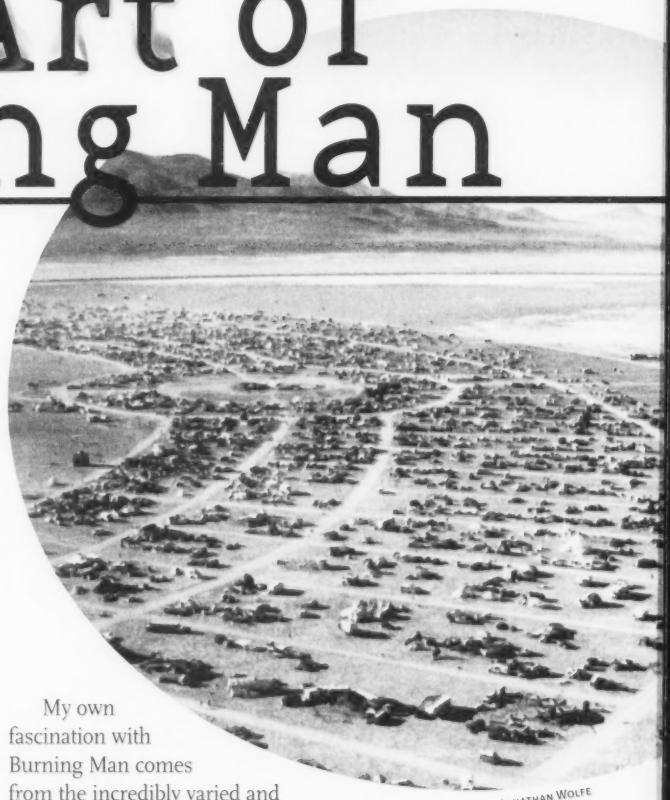
The sacred fire was lighted with great ceremony on Midsummer Eve; and on that night all the people of the adjacent country kept fixed watch on the western promontory of Howth, and the moment the first flash was seen from that spot the fact of ignition was announced with wild cries and cheers repeated from village to village, when all the local fires began to blaze, and Ireland was circled by a cordon of flame rising up from every hill. Then the dance and song began round every fire, and the wild hurrahs filled the air with the most frantic revelry. Many of these ancient customs are still continued, and the fires are still lighted on St. John's Eve on every hill in Ireland. When the fire has burned down to a red glow the young men strip to the waist and leap over or through the flames; this is done backwards and forwards several times, and he who braves the greatest blaze is considered the victor over the powers of evil, and is greeted with tremendous applause. When the fire burns still lower the young girls leap the flame, and those who leap clean over three times back and forward will be certain of a speedy marriage and good luck in after-life, with many children. The married women then walk through the lines of the burning embers; and when the fire is nearly burnt and trampled down, the yearling cattle are driven through the hot ashes, and their back is singed with a lighten hazel twig. These rods are kept safely afterwards, being considered of immense power to drive the cattle to and from the watering places. As the fire diminishes the shouting grows fainter, and the song and dance commence; while professional story-tellers narrate tales of fairy-land, or of the good old times long ago, when the kings and princes of Ireland dwelt amongst their own people, and there was food to eat and wine to drink for all comers to the feast at the king's house. When the crowd at length separate, every one carries home a brand from the fire, and great virtue is attached to the lighted *brone* which is safely carried to the house without breaking or falling to the ground. Many contests also arise amongst the young men; for whoever enters his house first with the sacred fire brings the good luck of the year with him. —*Ancient Legends, Mystic Charms, and Superstitions of Ireland*, Lady Wilde. 1887. ❋

The Art of Burning Man

by Kevin Kelly

Whatever Burning Man is, it is getting bigger. In 1997, 8,000 people hauled their bodies to the empty Nevada desert and made an instant city. In 1998 it was 14,000. This past summer, 23,000. Next year?

Black Rock City, as the town centered around Burning Man is known, is now the third largest city in Nevada, although it exists for only one week a year. It is also perhaps one of the best-designed cities in the world. It works wonderfully. It's safe enough for women to walk around naked. It's chock full of fantastic and real art. Transportation is primarily via bicycle. It's got a world-class view of a unique wilderness. Consumption is low and creation is high.



JONATHAN WOLFE

Above: Burning Man from the air.

Below: "Fire people" dispense kerosene street lanterns at dusk.

KEVIN KELLY

Left: While the rest of the encampment morphs day to day and year to year, the Man figure remains exactly the same, a creative constant.

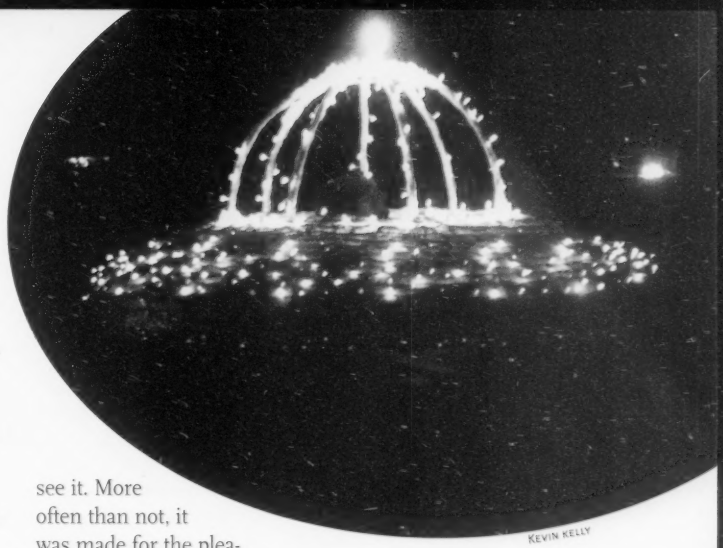
KEVIN KELLY

My own fascination with Burning Man comes from the incredibly varied and authentic art produced each year, and the distinct way it fills the heart of this instant town. The art ranges from hundreds of homemade banners flown in camps, to wild nomadic architectural experiments, to personal creative statements erected along the road, to spontaneous theater, to gigantic

and intricate installations that must take a year to create. Several qualities make the art of Burning Man some of the best being made these days.

First, it is art situated in a natural place. Most of the pieces, including the folk art, are birthed out of the particular climate and geography of the alkaline flat. It's environmental art, place art. The makings play off the emptiness, or the drabness, or the flatness of this particular place. Or they play off the absence of urban lights at night. They use the infinity of the clay playa itself to create something. Concepts that would not work in a room can shine in this stark world of wind and dust.

Second, the art is ubiquitous but not insistent. Burning Man's city is so vast now that it is way beyond the capabilities of a single person to see. You could walk days and not see every creation, every bit of impromptu theater, every bizarre juxtaposition (I've tried); but you're not supposed to. Some of the best pieces are built a long ways from the bustle; if you happen to walk out there and see it, great! There are no signs directing you there, no ads, no touting, no map, no tour, no desperate attempts to make sure you visit. The art is generous in that way. It doesn't demand that you see it. More often than not, it was made for the pleasure of making it. If you happen upon it and enjoy it, all the better.



KEVIN KELLY

Above: In empty blackness miles from the electric grid, messing with lights creates great effects. This saucer joins neon animals, lasers, and light-art of every kind.

Third, all the art is anonymous. There are no tags and labels, even for the best, most time-intensive creations. The most ambitious pieces take months to prepare, and thousands of dollars to create. They may be made by well-known artists (and some are) or by complete unknowns (and most are), but no distinction is even attempted. Without the striving that names bring, the art is easier to enjoy. The anonymity also nudges others to try making something—an object, a place, or an event. As the official Burning Man mandate goes—"No Spectators." The audience become artists (at least for a week) and the artists become the audience.

Last, there is no money inside. Perhaps the most radical design of Burning Man has been its nearly total prohibition of commerce within the city. This is not done out of any heavy socialistic impulse: after all, tickets at the gate cost $100.

KEVIN KELLY

Above: 23,000 in attendance; no cars allowed. "Main Street" bustles with bikes and pedestrians.

KEVIN KELLY

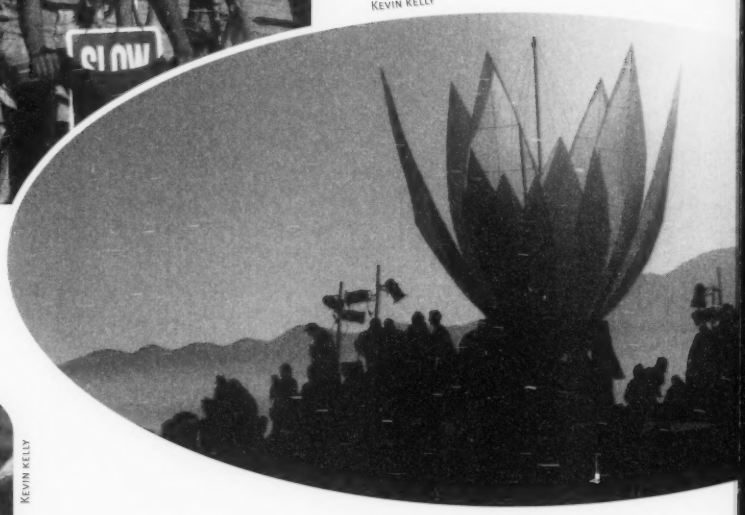
Below: Participants gather daily at the Man's feet, moments before the first ray of sunlight hits the figure to a chorus of cheers.

KEVIN KELLY

PETE SLINGLAND

Create-a-participant. Sculpture by Maggie Hallinan.

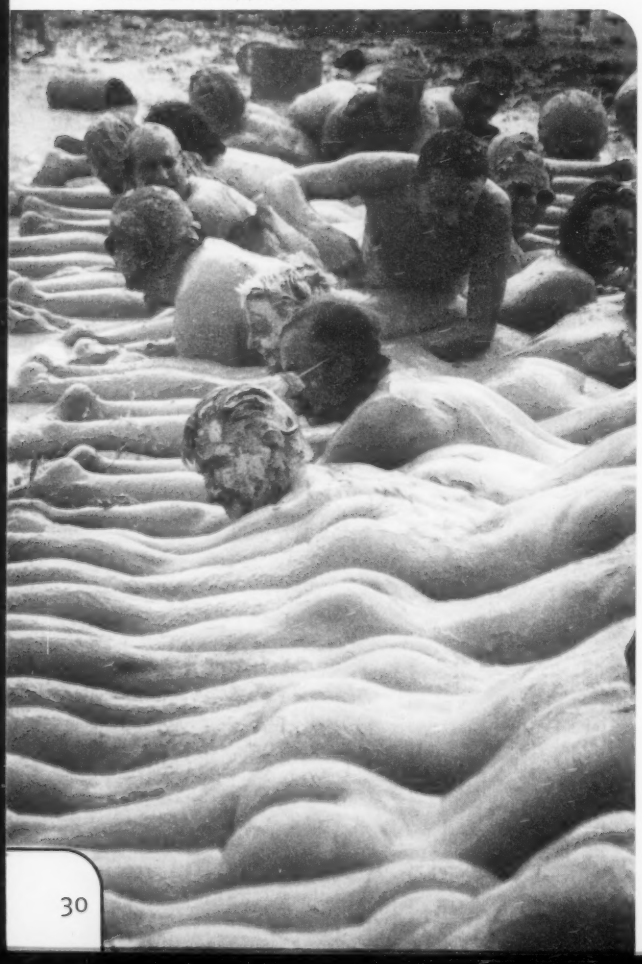
KEVIN KELLY



Above: It's a girl thing. Women doff their tops, whoop it up, and circle the Man.

Below: Man-made mud pool. The game was to slither over the rumps of others and at the end of the line become a rump yourself.

Right: Sail flower thing. "I have no idea what this is supposed to be; it was in the middle of a pile of sound equipment at a rave station." —KK



KEVIN KELLY

Rather it was a brilliant move to institute a zone of creation where the focus was on passion, expression, and gifts. For instance, it is perfectly acceptable to give away lemonade and snow cones, or cook free pancakes for all comers, and this is what indeed happens. The art is given away, which encourages others to make stuff to give away. To an extent I would not have believed possible, the banning of vending of any type, of advertising, of buying and selling (at least in the city itself) transformed the art of the city. The necessary survival self-reliance this entails (you've got to bring everything you need to live, since you can't buy anything) also births an artistic self-reliance.

How big can Burning Man get and still retain this wonderful sensibility? Few would have believed it could have grown to the size of a typical American town and still work in this exuberant way, but its founder, artist Larry Harvey, believes Burning Man could encompass 100,000 inhabitants or more and still work as a city of art. And that's what he is planning to do. I'm beginning to believe that it is possible. If you'd like to join (no spectators!), start with www.burningman.com. ❀

Kevin was editor of *Whole Earth Review*, and co-founder of the Hackers' Conference and the WELL (the first online community). He's now an editor at large for *WIRED*. He's written two provocative books: *Out of Control: The Rise of Neo-Biological Civilization* (Perseus, 1995) and *New Rules for the New Economy* (Viking, 1998). He's kind, and very supportive of our revival; he listens carefully, carries the best of Christian heartfulness, took his kids to Burning Man, and probes the optimistic techno mind/body/borg futures better than anyone I know. —PW

FRENCH, 1863

R.F.K. Is Gonna Burn

The Queen of Space and the God of Gods Order Fidel Zavos to Ignite the Senator

by John Barracato, with Peter Michelmore

The body of the murdered Senator was flown to New York on the evening of June 6, 1968, for the public viewing, and somewhere in the city was a maniac intent on making it a public cremation.

Two days earlier, Connell and I had responded to a suspicious fire in a tavern on Clarendon Road in Flatbush. The back rooms of the bar had been gutted. We inspected the area, wall by wall, until we found the telltale cone of scorching that marked the origin point of the fire on the plaster in the bathroom. Definitive lines across the cone marked the rising heat waves. At the foot of the triangle of burn, a yard out on the linoleum floor, were burnt fragments of a plastic valise, a man's chino pants, and a plaid jacket. The deeper charring of the linoleum and floor timbers underneath these remnants confirmed that the fire started here, almost certainly a bag of clothes set alight with a match. There were no electrical wires or outlets, and no gas jets nearby, to indicate an accident. And the floor charring was not severe enough for a gasoline blaze. Accelerant fires could sear through five or six inches of wood in heavy floor timbers in a matter of minutes. A regular fire ate into such wood at the rate of about one inch every hour. Barely a half inch had been burned away here.

Among the remnants of clothing we found a piece of a hard plastic badge, like an identification tag. We could make out a number, 147, and a location, Glassboro, New Jersey. A fast trip to Glassboro got us the information that this was a migrant farm worker's registration badge—and No. 147 had been issued to a man named Fidel Zavos late in May.

The name was familiar. The previous February I had arrested a Fidel Zavos for torching two churches in lower Flatbush. He had stood outside the second one, St. Matthew's, watching the flames light up the stained glass windows by the altar, and loudly proclaimed that his mother was the "queen of space" and his father "the god of gods." His parents were both dead, as it turned out, but Zavos said they had come to him in his dreams and commanded that he burn down all the churches on Earth and turn people away from the "false" God of the Bible. Zavos went straight from court to the Stoneville psychiatric hospital near Hicksville, Long Island, and I had assumed he would be there, under tight security, for a long, long time. Stoneville confirmed that Zavos had walked out of a hospital recreation room four weeks earlier and vanished.

We knew he had gone to Jersey for a brief period, but his fiery trail in a Flatbush bar indicated that he was back in his home territory and probably ready to strike against the churches. We returned to Flatbush on the afternoon of June 6 and began checking with local pastors to see if they had seen a wild-eyed Latin type with a pencil-thin mustache loitering about their churches. Some time during the night we had a message to contact Stoneville. I called from the Brooklyn dispatcher's office. One of the orderlies at the hospital had had a hysterical telephone call from Zavos in which he shrieked that the American people were now making a god of Robert Kennedy. His mother, the "queen of space," had ordered him to go to St. Patrick's Cathedral and burn Kennedy's body in the fires of hell.

"We gotta problem, John, an almighty problem," I told Connell when I hung up the phone. "Zavos has threatened to burn Robert Kennedy's body when it lies in state at St. Patrick's, and he's capable of carrying it through."

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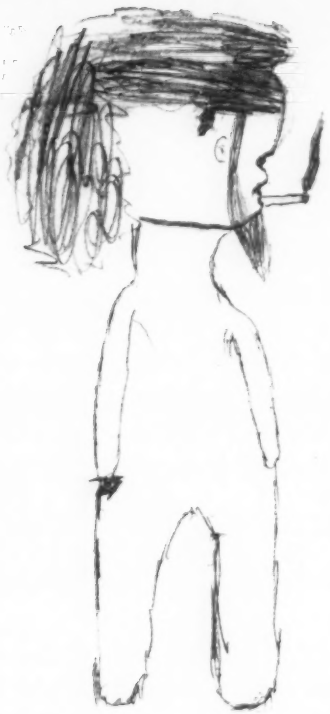


Above: "Please draw a man." Here, a child at risk for firesetting behavior instinctively adds a burning cigarette. From *Firesetting Children* (see access).

My mind would not dwell on the shock such a bestial act, or even an attempt at it, would send through an already grieving and shattered nation.

"We gotta find him, but where do we start?"

"It has to be in Manhattan or a subway ride away," said Connell.

"Right. Manhattan, or his familiar stamping ground of Flatbush or Canarsie."

"He doesn't have any money, as far as we know. Probably no regular place to stay."

"Right. That means a very cheap hotel or a flophouse."

Connell was on his feet.

For the rest of the night we visited every flop we could find in lower Brooklyn and lower Manhattan, including the fifty-cent-a-night joints off the Bowery. We had printed up dozens of pictures of Zavos for distribution to clergymen, and these we left with the night clerks with instructions to call our division headquarters if they spotted him. None could remember seeing him that particular night, but the clerks in these lousy hellholes did not look at faces as a rule—just the silver in the palsied palm.

At the Secret Service command post at St. Patrick's next morning, as the body of the assassinated Senator was being prepared for the viewing, we told of the threat and distributed more pictures. Agents agreed that we should join the detail assigned to watching the public lines forming outside, and for identity we were given tiny, round, enamel lapel buttons. The buttons were tricolored; the color of the day, red, to be worn topmost. We were further instructed not to mention Zavos's threat to any members of the Kennedy family.

Through that long, sad day at the cathedral, we waited and watched for Zavos. People were admitted for a time through the doors at the side of the central entrance, where they could be more easily studied by the Secret Service, but the Kennedy family asked that the main doors be opened. I was moved by the composure of the Kennedys; they were splendid. Jacqueline Kennedy thought to speak to several of the agents, thanking them for being there.

Of Zavos, however, there was not a sign, and around midnight I went home for sleep. The Senator's body was to be moved to Washington late the following afternoon. Soon the danger would be over.

At 4 A.M. the telephone rang by my bedside. It was a duty marshal from the bunkroom at headquarters. The desk manager at the Jackson Hotel, in the Bowery, had called to say that Zavos had just checked in.

I alerted John Connell at his home in Queens and we rendezvoused thirty minutes later outside the Jackson, a narrow, five-story brownstone hotel with a flickering green neon outside and a strip of threadbare carpet that started at the threshold and led through glass doors and down a hallway to the registration desk.

The clerk lifted a pink, scaling face at our approach.

"Your party's in cubicle twelve, second floor. You want the light on up there?"

"No light. And you stay here. Is the cubicle locked?"

"Hook-and-eye catch, from the inside."

We climbed the stairs to a huge open wardroom. Fifty beds, at least, were pushed close together down either side of the wall and most were humped with sleeping men, and, probably, women too. This was skid row at rest.

"Jesus!" Connell grimaced and pinched his thumb and forefinger over his nose. The stench of sour wine and sweat and urine overpowered.

We walked down the aisle between the beds to the cubicles, like toilet stalls, at the far end of the room. For the privacy of a bed in one of the stalls the tab was hiked twenty-five cents.

Twelve was marked with big house numbers nailed on a plywood door. It was open at the top, the walls about seven feet high.

"I'll go over the wall," I whispered to Connell. "This guy carries a knife. If we bust in there he might have time to use it."

I gripped the top of the wall beam, threw a leg up, and was quickly over the other side. I flipped the door lock and then grabbed Zavos under the shoulder and threw him bodily to the floor.

"Freeze!" Connell had his gun pointed at Zavos's temple.

My right hand went under the pillow. Nothing. I slithered it under the mattress and felt the hard butt of

a knife. As I withdrew it I felt a sting on the top of my hand.

"May I know what is going on?" Zavos's voice was very English, very formal.

"No, you may not, you sonofabitch," said Connell.

We handed him his clothes piece by piece from the chair at the foot of the bed, then we handcuffed him and took him out past the sleeping derelicts. Not one of them had stirred through the whole proceeding.

"What in Christ's name do you think they are dreaming about?" Connell muttered.

"Thunderbird wine," I said. My knuckle itched and I was sucking on it.

In the car we searched Zavos's pockets and found the key to a locker at Pennsylvania Station.

"Is this where you keep the shit?" asked Connell.

"I do not make shit, I make fires," Zavos replied. His tone was calm but he had a silver glitter in his eyes that made me shiver.

He pulled on my shoulder. "Thank you for catching me, marshal, once again. I was going to burn Bobby Kennedy. The 'queen of space' told me to burn him and I said I could not. She said I must because my father ordered it."

"Is the shit at Penn?" Connell had no respect for the insane.

"Oh, yes."

We found a brown paper shopping bag in the locker containing a gallon can of paint thinners, plus two quart bottles half full of the same inflammatory stuff.

"I stood in line at the cathedral with my shopping bag today," Zavos explained, "but it was moving too slow, and I decided to leave and go back this morning."

After we booked him at the precinct near Penn Station I called the Secret Service. I was assured that he would have had no chance of getting into the cathedral carrying a shopping bag full of paint thinners in bottles and cans. But I wondered about that. Only marshals are trained to think of fire as a weapon. Numerous people buy paint thinners for cleaning up paint smudges at home. It is a harmless liquid unless put to the match. Would the agent at the door when Zavos arrived have made a diabolical connection?

I had trouble typing my report on the case because my right hand was swelling up like a melon and turning purple. A physician available to us at the Municipal Building said I had blood poisoning. He drained the infection and swathed my hand in bandages.

What hit me in Zavos's cubicle must have been a cross between a roach and centipede. I carry the scar to this day.

One of the press information officers at the Fire Department, in issuing a short account, talked to me and, seeing the bandages, assumed I had been wounded by a knife or gunfire. The *Daily News* carried a story and the next day I was instructed to appear at a seminar being conducted at the United Nations by the American Federation of Police. The subject, I believe, was the bombings that were then part of the antiwar resistance in the United States.

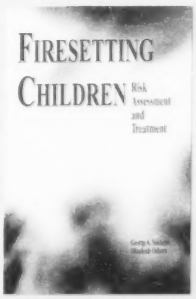
I was called to the platform at the seminar and grandly presented with a plaque honoring me for meritorious conduct.

"And as you can see," said the police captain making the award, "Marshal John Barracato was wounded in the line of duty." ❀

Right: "Please draw a house." The child, a firesetter, draws a house that is clearly on fire. From *Firesetting Children* (see access).

Arson sports many motivations besides loose circuits. Vandals and some children, considered sociopathic, prefer vacant buildings and schools for fuel. White-collar schemers pay colleagues to burn offices and papers to conceal crimes. Wives, husbands, jilted lovers, fired employees, and many more burn for revenge, spite, and mysterious complex kindlings called desire. Fundamentalists, bigots, and ideological believers ignite churches and books for nation and God. In the extreme, arson torches other humans. I had a classmate in junior high who wound up in juvie for dropping matches on sleeping homeless people who used newspapers for blankets. Arson is ultimately any crime against humanity with a incendiary weapon. —PW

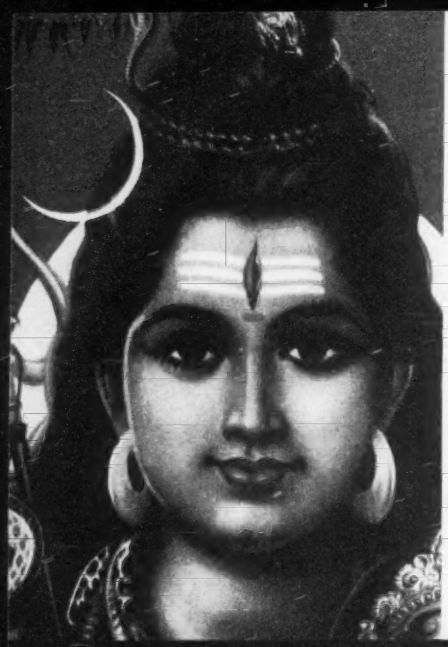
Spotting the Young Arsonist



FIRESETTING CHILDREN
Risk Assessment and Treatment

George A. Sakheim and Elizabeth Osborn. 1994; 68 pp. $14.95. Child Welfare League of America, Inc., 440 First Street, NW. Suite 310, Washington, DC 20001. 800/407-6273, 202/638-2952, www.cwla.org.

Nature or nurture: what ignites young firesetters? CWLA describes the personalities, behaviors, and family variables to look for. —NP



Uma and Shiva, or The Origin of a Young God

The Hindu Story of Fire, Desire, and Bringing Order to the World

as retold by Sadie Hadley

Above: Shiva and Uma, from a pop Bombay street poster.

This is a story of how heat—in gods, goddesses, and humans with god-like qualities—brings together sex and austerity, ecological chaos and seasonal order, men and women, devotion and terror, terrestrial and celestial fire, magic and domesticity in the world as we know it. Like all Hindu stories, it overflows with myriad themes, tales of origin, and histories. Kalidasa, an Indian-born playwright/poet, wrote the *Kumarasambhava* (*The Origin of a Young God*) in the fifth century C.E.

Fire in Vedic mythology hides in water; sometimes as the seed that sparks the fertility of the womb or creativity of the mind. Originally heat was inseparable from water; the two were merged in a pure, unidentifiable, indescribable, attributeless state called Brahman. Something stirs within this state. That which stirs is desire. From desire arises heat. Water and fire move apart.

One way of reading this story is that the two central characters, Uma and Shiva, must be reunited to restore order to the seasons and the biosphere's water and heat cycles, to ensure the continuation of a balanced cosmos. Uma is water and Shiva, fire. Only when female and male come together and produce a child, Kumara, can the demonic forces upsetting the world of all beings be effectively fought. The legend's journey includes many aspects of heat—burning devotion and the fervor of mystic rapture; wild sex and unstoppable passion; a desire to mobilize one's personal inner heat to incinerate lust and cosmic defilements; sudden fiery wrath that can kill. Heat in Hindu religious legends can feed on itself and burst into emotional and spiritual flames; and, with majesty, merge humans to divinities, Earth to Heaven, and everything in between.

The Sanskrit word *tapas* is conventionally translated as "austerities." But its root, *tap*, means "to heat." It eventually came to mean "generating magical or supernatural powers by accessing one's internal heat/fire through asceticism" (suffering physical pain and arduous meditation). By practicing *tapas*, an individual accesses the original creative energy of the cosmos described as Brahman. She/he identifies and witnesses herself/himself as that pure attributeless state of existence before fire and water moved apart. In this austere state, the inner fire of desire merges with the outer fires (sun, lightning, volcanic fire, cosmic fire). Note that heat is not a force created by gods and stolen by humans. It is a primordial force used by both. In this sense, the Hindu intuition is close to modern physics. Heat is mobile, is bound to no space, departs and enters various phenomena (human body, air, universe). Fire is not primarily destructive. Without fire—emerging from water or called up by the practice of *tapas*—creation doesn't exist.

A fun way to read this story is ecologically. *Tapas* can bring renewal and maintenance on a human, biospheric, divine, and cosmic level when used in beautiful and beneficial ways by any of its practitioners. It perpetuates creativity. Or it can be used in a destructive fashion that increases suffering. Today, the heat of industrial combustion is excessive, out of balance with the water cycle, upsetting the waters (rain, ocean temperatures, ice caps) of the planet. In harmony with water, heat/fire helps form an auspicious volume of rain clouds, which in turn bring moisture to seeds in parched soil. In this story, the upsetter of

cosmic order is the demonic Taraka. Here then is the story of creative energy, the origin of a young god....

The Story of Uma and Shiva

Uma was the wife of Shiva in her previous incarnation as Sati. Because Sati had had some unloving karma with her father, she died and has been reborn as Uma. Shiva is devastated over the loss of Sati. He has renounced sex, and retreats to the mountains intending solely to practice *tapas*. This is interesting because Shiva is the force, is *tapas*; he is fire energy. So it sounds absurd for Shiva, who is the source of fire energy, to go and practice *tapas*. But he does, because he wants his inner heat to purify him of all desires—to fight fire with fire.

Uma is born (reborn) and comes back specifically to be with Shiva. She remembers Shiva, but Shiva does not remember her. She knows what her previous incarnation was, her marriage to Shiva as Sati. Destined to become Shiva's wife (again), Uma is impeded: Shiva has renounced his sexuality.

Meanwhile, there is an *asura*. The way I think of *asuras* is that they exemplify humans' capacity to become submerged in the desire realm, experiencing greed and hatred. *Asuras* are demons that thrive in the desire realm. This story's *asura* is named Taraka, and he has practiced so many *tapas* that he has produced huge amounts of heat. He is using this power in a really negative way. Taraka creates disorder. The seasons abandon their orderly procession and dedicate themselves to amassing power for him; the ocean waits for its jewels to ripen in order to present them to him; the wind blows only as hard as a soft fan so as not to disturb him. Taraka steals peaks from Mount Mera to erect on his own land, diverts the Ganges so he can have the lotus fields for his own pleasure-lakes, and steals priests' oblations from other gods at all the fire sacrifices. The seasons, the natural world, and the gods are terrified of him because of his immense powers. He has temporarily assumed supreme power over all the gods and the worlds as a result of having accumulated so much power through his own practice of *tapas*. The way the sacred texts describe him is, he tortures the three worlds—Heaven, Earth, and the space in between.

All of the gods are totally distraught because none of them can overcome him. None of them can overcome him because the supreme creative power, Brahma, witnessed the amount of power that Taraka was developing from performing these *tapas*, and thought: "This fiery force of Taraka's can burn the three worlds." Brahma made a bargain. He gave Taraka absolute power, but said: "You can't destroy the cosmos. In exchange for your not doing that, no other gods can destroy you." The gods all try to fight him in battle and none can destroy him. Vishnu, for instance, throws his sacred discus (one of the most powerful things in the universe) at him, and when the discus hits Taraka, it sends up a ray of fire and turns into a small pendant hanging around his neck.

So the gods go to Brahma. They pray, and pray, and say: "You're the creative energy of the entire cosmos, you have to help us because this being (Taraka) is causing such disorder and is torturing us. We're all living in constant fear. Can you please help us?"

Brahma says that the only being who can help is the seed of Shiva and Uma. If Uma is water and Shiva is fire (this is the way that I interpret it), then, Brahma says, only if these two beings come together and produce a child will Taraka be destroyed. This child can become a general and lead armies into battle against Taraka and defeat him.

The gods then have to conspire to get Uma and Shiva together; this is difficult because Shiva has been in a state of relinquishment, practicing *tapas* up on the mountains, and doesn't want to be distracted by a woman.

Indra (a divinity associated with rain and thunder) goes to the god of love and fascination, Kama, and says, "Kama, we really need your help; help us get Shiva to fall in love with Uma."

Kama is really scared, but says okay. He goes with his wife, Rati, to the mountains where Shiva is. Uma, with two of her girlfriends, goes to the same mountains at the same time. She is going to offer herself as Shiva's servant while he practices his austerities. Kama and Rati hide behind some trees. When Kama sees Shiva, he is terrified and intimidated by how powerful and how ugly Shiva is—snakes holding up his matted hair, covered with ashes from a funeral pyre, sitting on a tiger skin in deep meditation, with his nine gates closed, witnessing only his inner Self. Kama's bow and flower-arrows slip from his hand in a moment of sheer terror.

Just then Uma enters the meditation grove—curved forward from the weight of her bosom, her dress the color of the sun, adorned with spring blossoms. A bee buzzes her lower lip, thirsty for her sweet breath. Kama, struck by her beauty, thinking that it puts even Rati's to shame, feels his strength return, and picks up his bow and arrows.

Uma bows to Shiva and, for a split second, Shiva's concentration breaks. Shiva thinks, "What could be

Left to right: Brahma, the supreme creative power; Vishnu, with his sacred discus that Taraka wears as jewelry; and Shiva. Engraving from a 19th-century encyclopedia.

Top: Shiva sits in the warm lap of Mother Earth. Pahari School, c. 18th century.

Bottom: Uma the ascetic. Rajasthan, c. 19th century.

here that could possibly break my concentration? It can't be this woman." So he sends out his sacred vision (he has three eyes and can see in all directions). He sees Kama hiding in the woods. Kama is thinking that this is the perfect time to shoot his arrow of fascination, which always works. He is just about to release the arrow when Shiva spots him and, from his third eye, shoots a ray of lightning because he is so angry that anyone would disrupt his practice of *tapas*. The ray of lightning hits Kama and he turns to ashes: gone, burned, destroyed.

Rati faints. She is devastated, not believing that Shiva would be so uncompassionate as to burn Kama on the spot. Uma is distraught and feels totally rejected. She goes running back to Himalaya, her father, who is the mountain raja (both mountain range and living god), and he takes her into his arms and tries to console her. Uma decides that she must win Shiva's love by demonstrating her ability to match him in his highest skill—the practice of *tapas*.

Her mother tries to dissuade her and tells her that all the other gods would love to marry her; that she is the most beautiful woman in the entire universe, et cetera. "You shouldn't take this personally from Shiva. It's no reason to go off and practice *tapas*." But Uma knows that the only way that she will ever get Shiva's attention is if she renounces the world and practices austerities.

(Meanwhile Indra has consoled Rati. If Shiva and Uma get together, Kama will be given another body that has the same form that he had before, and he will remember Rati; things will pick up exactly where they ended.)

Uma goes off to the woods and dresses herself in bark clothing that scratches and rubs her raw. She is described as having these huge voluptuous breasts and beautiful dripping-red, melon-like lips. She practices austerities, becoming skinnier and skinnier, but she maintains her beauty. Because Uma exudes her *tapas*, the energy that she brings to the forest is so beautiful and so soothing that she creates bliss all around her. When she's practicing her austerities Uma sends off steam. This heat rises and becomes rain, and it rains on the Earth. She exemplifies the whole ecological cycle of heat rising and producing rain clouds and rain coming down and germinating seeds. Her austerities and energy tame the deer, and the relationship between prey and predator becomes benign and loving.

She passes cold winter nights standing in sheets of sleet and snow, while feeling pity for cold birds and wilting lotuses. She is called "The Lady Who Refused the Leaves," because she refuses to even eat the leaves which have dropped from the trees of their own accord, going beyond the farthest limits of *tapas*.

After several years of Uma's practicing austerities, a sage comes to the woods where she is. He sits down next to her and she welcomes him. He starts asking her questions: "Why are you doing this? A woman of such beauty shouldn't be practicing austerities. Attain a husband! The purpose of practicing austerities is to remove oneself from the desire realm, and what are you doing here? Why are you doing this?"

She is too shy to tell him. She has a friend with her who is also a sage, and her friend tells him that Uma has been practicing these austerities because she is a Shiva devotee and there is nothing in the cosmos that is as important as devoting oneself to Shiva. The sage starts putting Shiva down: "How, why on Earth would you ever want to be with so ugly a man who has three eyes and is covered with ashes and has snakes around his wrist and in his hair? He's disgusting, scary. A woman of your beauty should never desire to be with a god as revolting as Shiva."

Uma, incredibly angry, says, "How can you be a sage and have practiced austerities and not understand what it is to devote oneself to Shiva?" She defends Shiva. He is the Shelter of the Universe who is beyond desire (though he is her only desire). In practicing *tapas*, he has nothing. But he is the source of all riches (the state of Brahman, fire-in-water). Uma says she doesn't want to argue anymore, and that these insults are beneath her. She repeats that her heart is full of love for Shiva, and that obviously the sage has gained no wisdom from his *tapas*.

As she turns to leave, the "sage" returns to his own form as Shiva, sweeps her up in his arms, and states, "From this moment on, I am your slave, gained by *tapas*."

Uma is stunned. She can't move. She can't breath.

The Fire of Desire

They get married. There is a beautiful description of the wedding. Himalaya and Mena, Uma's parents, throw the marriage ceremony with a huge festival, and all of the gods and goddesses attend. They're all in complete awe of

Shiva. His light is so bright that they can't even look at him. Uma is so beautiful that all the gods don't want Shiva to know how desirous they are. When Uma and Shiva walk by together, the gods pop third eyes and fourth eyes onto the back of their heads, so they can continue looking at Uma, and Shiva won't know.

Shiva takes Uma to Mount Kylash for their honeymoon They have sex for years. Then they take a little break. Uma gets up and looks at herself in the mirror and sees she's covered with bites and scratch marks and her hair is all messed up and dreaded and knotted from love play. Shiva gets so excited looking at her that he pulls her back into bed and they have sex for twenty-five more years. She then becomes impregnated with the young god, Kumara, who becomes a general leading armies in the defeat of the demonic *asura* Taraka.

That's the story. ❀

Above: The heat of passionate union, shown as an iconic flame with symbols representing the regions from the belly upwards to the mind. Nepal, c. 17th century.

First a kinship confessional. Sadie considers me her "very successful stepdad." Before I knew her, she lived on a ranch forty miles from Douglas, AZ that could be reached only by crossing a series of arroyos dozens of times. She's a border kid, chatting in Spanish and hanging at drive-ins. Since I met her, she's studied anthropology at Evergreen College, lived in Nepal (she chats in Nepali), and just graduated from St. John's (Santa Fe) in East Asian classics and Sanskrit. Now the kinship part: She has just about the sweetest heart, most interesting dreamworld, and gentlest ability to accurately tease kids and adults on important aspects of their personal foibles that I have ever experienced. This is her first published magazine article. —PW

The Psychoanalysis of Fire

Gaston Bachelard. (Translated by Alan C.M. Ross.) 1968 (reprint ed.); 115 pp. $15.50. Beacon Press.

Eloquent. Not the physics or ecology, but the poetic imagination of fire. Fire and Respect. Fire and Reverie. Sexualized Fire. Firewater (brandy) and spontaneous combustion. Idealized Fire. Fire and Purity. Original Fire. Now over sixty years old, this short book contains more engaging paragraphs and thoughts about fire than anything before or since. He's pyromantic and perspicacious; thanks, Gaston Bachelard. —PW

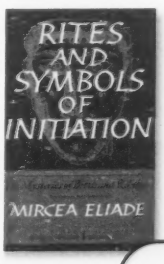
❝ Fire and heat provide modes of explanation in the most varied domains, because they have been for us the occasion for unforgettable memories, for simple and decisive personal experiences. Fire is thus a privileged phenomenon which can explain anything. If all that changes slowly may be explained by life, all that changes quickly is explained by fire. Fire is the ultra-living element. It is intimate and it is universal. It lives in our heart. It lives in the sky. It rises from the depths of the substance and offers itself with the warmth of love. Or it can go back down into the substance and hide there, latent and pent-up, like hate and vengeance. Among all phenomena, it is really the only one to which there can be so definitely attributed the opposing values of good and evil. It shines in Paradise. It burns in Hell. It is gentleness and torture. It is cookery and it is apocalypse. It is a pleasure for the *good* child sitting prudently by the hearth; yet it punishes any disobedience when the child wishes to play too close to its flames. It is well-being and it is respect. It is a tutelary and a terrible divinity, both good and bad. It can contradict itself; thus it is one of the principles of universal explanation.

❝ In one Australian tribe the legend is very amusing, or, rather, it is because a bird is being amusing that it succeeds in stealing the fire. "The deaf adder had formerly the sole possession of fire, which he kept securely in his inside. All the birds tried in vain to get some of it, until the small hawk came along and played such ridiculous antics that the adder could not keep his countenance and began to laugh. Then the fire escaped from him and became common property." Thus, as is often the case, the legend of fire is the legend of licentious love. Fire is associated with innumerable jokes.

Rites and Symbols of Initiation
The Mysteries of Birth and Rebirth

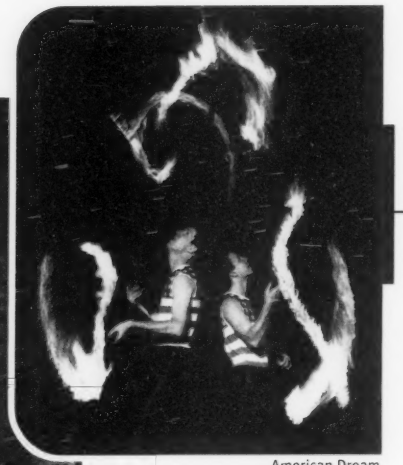
Mircea Eliade. 1994 (reprint ed.); 175 pp. $17.50. Spring Publications.

The master's introduction to the practices—including the techniques and mystiques of fire—through which cultures from archaic to contemporary act out their drive to transform and transfigure mundane existence. —MKS



All illustrations from *4,000 Years of Juggling*, scheduled for release by Brian Dubé, Inc. in 2000.

J.T. Doyle.

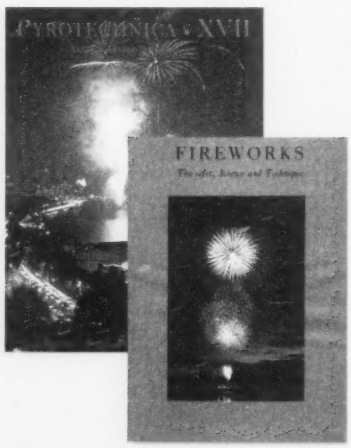


American Dream.

Ray Jason/4 Torches.

Laban Pheidias.

Pyrotechnical Access



PYROTECHNICA
Occasional Papers in Pyrotechnics

Published irregularly, as submitted articles warrant; cost varies. Pyrotechnica Publications, PO Box 611, Post Falls, ID 83877. 208/664-0388, pyropubs@aol.com.

The foremost magazine devoted exclusively to the display and building of fireworks—a marvel for the eyes and brain. (Interested readers are notified as each new issue is published.)

FIREWORKS: THE ART, SCIENCE AND TECHNIQUE
Takeo Shimizu. 1996 (3rd ed.); 344 pp. $65. Pyrotechnica Publications (see above).

Pyrotechnica calls this "the Bible of the fireworks amateur." Renowned Japanese pyrotechnician Shimizu tells all: If you want to make your own, or dominate conversation on July 4th, this is the sure burn.

PYROTECHNICS GUILD INTERNATIONAL, INC.
PGI, 3944 Carthage Road, Randallstown, MD 21133. jrsrocket@aol.com, www.pgi.org. Annual membership ($50 the first year, $25 thereafter) includes subscription to PGI Bulletin *(5 issues/year).*

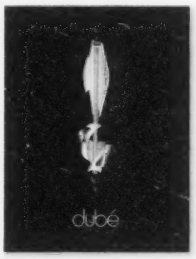
PGI was founded in 1969 to educate not only fireworks enthusiasts, but also the media, politicians, and the public. Members range from curious laypeople to pros.

AMERICAN PYROTECHNICS ASSOCIATION
PO Box 30438, Bethesda, MD 20824. 301/907-8181, info@americanpyro.com, www.americanpyro.com.

The leading trade association of the industry. Safety tips, laws, history, "Ask The Expert," and more.

FIREWORKS BOOKS AND VIDEOS ONLINE
www.skylighter.com/books.htm.

Pages and pages of them. Component parts, too, with specs.



Dubé Catalog of Juggling Equipment

Brian Dubé, Inc., 520 Broadway, 3rd Floor, New York, NY 10012. 212/941-0060, info@dube.com, www.dube.com.

Brian Dubé is one of the longest established and most innovative of prop manufacturers. His European-style clubs (comfortable to catch, easy to juggle in large numbers, durable when dropped) have set the standard for a generation of jugglers.

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Most modern club- and fire-swinging acts can trace their ancestry to an old book on the subject Brian Dubé found and reprinted (*Club Swinging for Physical Exercise and Recreation,* by W.J. Schatz. American Gymnasia Company, 1908; reprint edition available through the catalog).

With this kind of backbone, the *Dubé Catalog*—thirty pages long this year and packed with props, books, and videos for jugglers—is one of the industry's best. —Andrew Conway, Juggling Hall of Fame committee and curator of the Internet Museum of Juggling (www.juggling.org/museum)

Juggling Access

Renegade Juggling
PO Box 406, Santa Cruz, CA 95061. 831/426-7343, sales@renegadejuggling.com, www.renegadejuggling.com.

Renegade is best known for its custom-made, variable-thickness clubs—and for introducing late-night open-mic cabaret shows at juggling festivals all over the world. —AC

Todd Smith Products
1340 Lakeshore Boulevard, Cleveland, OH 44110, 800/584-4531, 216/761-6388, todd@toddsmith.com, www.toddsmith.com.

Todd's quality and customer service inspire devoted customers. His "Satellite" line of lightweight, mylar-covered clubs is the showiest around. —AC

Mister Babache
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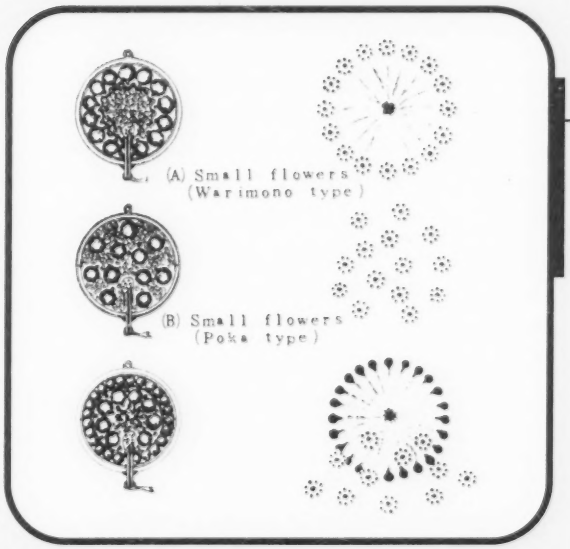
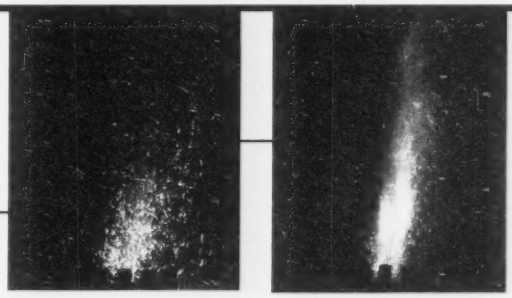
This Swiss company set the standard for high-quality diabolos. Their complete range of props includes kid-sized clubs. —AC

Jugglers' Information Service
www.juggling.org.

Virtual access to every scrap of info you can juggle, with links galore.

Below: "Flower Garden" shell arrangements and resulting displays. From *Fireworks: The Art, Science and Technique.*





Above: Static tests of tiger-tail comets made from (left) mesquite charcoal and (right) oak. Hemp charcoal (not shown) scored best for billows, sparks, and hang time. From *Pyrotechnica* XVII.

Right: Founding members of the fireworks club in Mosta, Malta (now the "15th of August Pyrotechnic Society"), 1951. From *Pyrotechnica* XI.

Domestic Fire

With village life, caring for the domestic flame grew to a communal responsibility. Clustered homes, constructed of wood and straw—dried fuels—fanned images of escaped fire. When a bell rang each night, law required all villagers to cover their fires with ash, to ensure that fireplaces didn't spark disaster. The night bell was known as the bell of *couvre-feu* ("cover fire"), or curfew.

Domestic fire was (and still is, in many homes) a holy triumvirate. It cooked; it lit; it heated. This multiplicity was attractive, and the hearth focused the householders ("focus" originally meant "hearth"). The hearth taught responsibility in the feeding and tending of fire, and illuminated the stories and education of most humans. Over the past four centuries, this triple gift of domestic fire has been teased apart into convenient and safe fixtures. A lamp is not a radiator is not a stove, though in essence they are all fire.

Stoves, lamps, and space heaters must be ignited. What are your home igniters? Because the act of ignition is almost a forgotten event of human history, *Whole Earth* tracks the history of domestic ignition—from stealing lightning-fire to rubbing sticks to the throwaway lighter (page 41). My favorite quote from Ishi, the last Yahi, who wandered starving into a California ranch, came when he was asked what he thought of white men's technology. He answered that he treasured only two things: matches and glue. Matches, the great democratizers of easy ignition, changed everything. Children stopped visiting neighbors to borrow hot coals when the home fire went out. The sharing of fire has devolved into one Bic, three cigarettes.

In industrialized nations, the stove/oven became specialized, distancing itself from space heating and light fixtures to become a standalone household utility. As Daphne Derven explains (page 50), changes in utensils, fuels, and cooking styles changed our tastes in food. The roasting spit is not the microwave. On the other hand, the cooking stoves of perhaps two billion or more citizens still rely on charcoal, fuelwood, and forests. In a letter from Kenya, Elsen Karstad describes an innovation for collecting waste charcoal and using it, instead of virgin charcoal, for stove fuel (page 43).

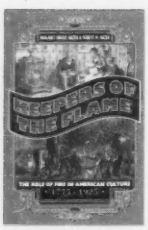
We ignore our choice of fuels only at a peril to the biosphere. Industrial combustion causes greenhouse gases. The most effective forest savior was not the wilderness movement but the substitution of petrofuels for wood-based heating and cooking. We are still sensitive to this transition. During fossil-fuel shortages, the demand for and price of fuelwood go up. Both fuel and ignition have been given short shrift in our educational focus. The flame has been hidden in the electric coil, the radiant-heat plate, and the microwave. The return of solar energy as the primal source of photon-based fuel signals the first return of domestic conversation about which energy should power our warmth and cook our food (page 48).

Home heating has evolved into space heaters and redesigning the home with specially engineered windows, calculated R-factors, and well-insulated walls—the home itself becomes the hearth. Fire vanishes. It is a story we have covered before and will update in later issues.

Finally, home lighting escaped dependence on the fireplace's glow, and was confined to smaller and smaller sources with more and more focused lumens. Candles, oil lamps, limelights; then electric arcs and filament lamps; and now long-lived fluorescents, have balanced inventions, economics, eye-ease, and aesthetics. Still, most light bulbs are remarkably inefficient (using 95 percent of their energy as heat, not light). Future innovations may employ glowworms or mineral mixes, in homes designed with topographic orientations, special windows, and skylights that encourage sunlight into the cave.

No matter what occurs, the original multipurpose hearth is an endangered, if not extinct, experience. —PW

In this diorama, light from a single candle is concentrated through the "lenses" of water-filled globes, each illuminating a lacemaker's work space. Photo from *Lengthening the Day* (see access, page 46).



KEEPERS OF THE FLAME
The Role of Fire in American Culture 1775–1925

Margaret Hindle Hazen and Robert M. Hazen. 1992; 281 pp. $47.50. Princeton University Press.

Not exclusively about domesticated fire, but its chapters on keeping the home fires burning are its most perfect flames. An academic book with great illustrations and lots of interesting fire facts about us. —PW

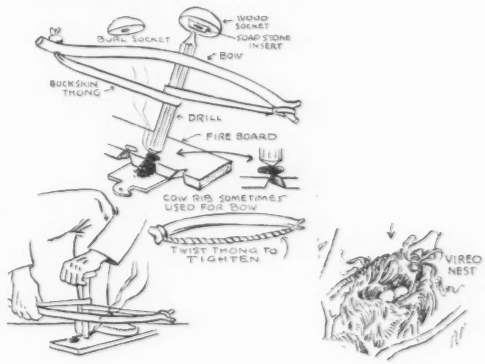
Fire-Starters

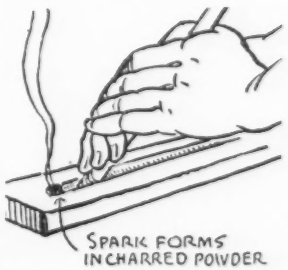
A History of Ignition

All photos from *The Legend of the Lighter* (see access). All drawings, except clay pot, from *Wildwood Wisdom* (see access).

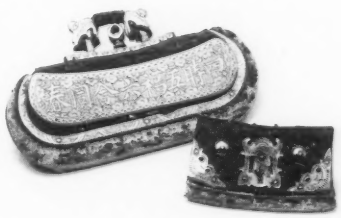
Stephanie Johnston

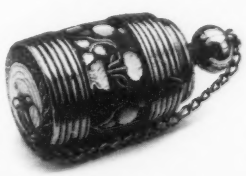
Clay pot for transporting hot coals from Kashmir. Before clay, embers were surrounded by leaves and transported in hollow stalks, horns, and special pots of stone or bamboo. The hot coals came from natural burns. Many pots had tiny holes so that when the coals began to die, they could be whirled about or blown upon to keep them alive. A dead pot was a disaster, and the "perpetual fire" rituals had obvious importance.





Fire ignited by hard work. Fire drills, bows, and "ploughs" used friction to ignite tinder from hot spots. Pyrite stones produced sparks when knocked together. Animal nests, dung, and dried agaric mushrooms were early favorite tinder to "catch" the spark or burning fire board.

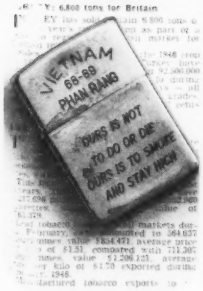


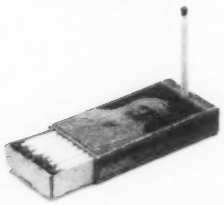


With the discovery that you could knock big sparks out of pieces of iron pyrite, fire-starting turned to steel and flint. Steel/flint ignition still required tinder, which now included old rags, weathered hemp rope, and specially prepared agaric. The Chinese pouches for tinder (with the flint and steel sewn in) were called chuck mucks. They can be considered the first lighters, as they assembled igniter and tinder into a single package. The tinder box shown is from Europe.

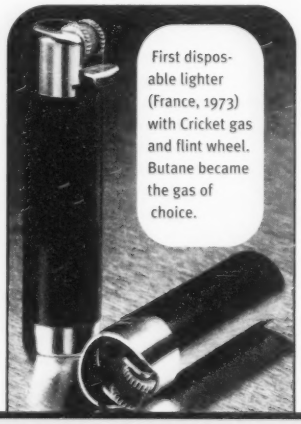
Mid-1660s. Tinder pistols added gunpowder and became the first "lighters." The barrel became the tinder box. An abundance of broken pistols spurred the business.

In the 19th and 20th centuries, a grand diversity of lighters appeared. The luminous gasoline table lighter with an electrochemical filament and two fuses (France, 1880) was an early experiment with gaseous fuels. The Stohr electric-spark and wall lighters (Germany, 1940) foreshadowed car lighters. The extremely popular gasoline and flint-wheel Zippo pocket lighter (US, 1932) sold hundreds of thousands.



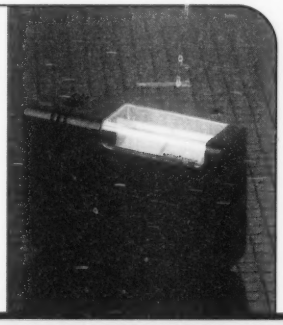


Matches have a parallel history to lighters. They started with hazardous sulfur-tipped sticks in Roman times, then switched to dangerous white phosphorus (it ignited in the sun and inhalation caused badly disfigured jaws and teeth). After many attempts, a red phosphorus "safety match" was invented in Sweden and took off as a cigarette lighter during the Crimean War of the 1850s. Illustrated are wood and paper matches (1850s); candle matches with attachment for bedside "lamp" (1870s); and a French "fusee," with emery flint pocket lighter and match holder.



First disposable lighter (France, 1973) with Cricket gas and flint wheel. Butane became the gas of choice.

It was the Chinese who perfected lenses to spark a flame; others followed. Below: A European upper-class combo to focus the sun on tinder (Great Britain, 1700s). Right: The first solar lighter using "solartronic gas" and a battery spark (Germany, 1973).



WILDWOOD WISDOM
Ellsworth Jaeger. 1992 (1st Shelter Printing); 491 pp. $14.95. Shelter Publications/Random House.

THE LEGEND OF THE LIGHTER
Ad van Weert. 1995; 192 pp. $45. Abbeville Press.

PRIMITIVE TECHNOLOGY
A Book of Earth Skills
David Wescott, ed. 1999; 248 pp. $24.95. Gibbs-Smith.

1000 CIGARETTE LIGHTERS
Günter W. Broesan. 1995; 291 pp. $75 postpaid. D-79227 Schallstadt, Lindenstr. 6b, Germany. broesan@aol.com, www.bltravel.com/broesan.htm.

MARK EDWARDS/EARTHSCAN

Can Waste Charcoal Powder Save Forests?

A Letter from Kenya

Stovers:

I've been busy working toward proving that the salvage and briquetting of waste charcoal powder collected from vendors' sites in Nairobi can be a commercially viable operation. Here's an update.

I'm up to a production level of two tons [of charcoal powder made into briquettes] each day now, and am stockpiling—producing more than I'm selling.

So the bottleneck now is in sales rather than in production, though I would like to upgrade from the small 100 kg/hour extruders I'm operating. (STILL haven't rec'd any information on alternative briquetting equipment...Help?!)

A couple of months ago I entered into discussion with the German aid agency GTZ, which has assumed responsibility for implementing the firewood supply program to 160,000 refugees in camps here in Kenya. Considering the real and potential environmental impacts of providing each one of these refugees with one kg of wood every day, my VWB [Vendors Waste Briquettes] seems a sound and "friendly" alternative...though the potential replacement demand for VWB at around forty tons/day may never be met by my product alone.

GTZ agreed on a trial—but hell might be several degrees cooler before the machinery gets into gear....So far it's been a couple months since that was agreed upon and a succession of long leaves amongst critical implementing personnel has negated any forward movement....

I'm beginning to think that the refugees are in enough hands at the moment (no comment on quality of care), and am focusing on the many institutions around Nairobi that use firewood for fuel (cooking and water heating), from tourist camps through schools to orphanages and the like. So far so good—the charcoal has been very well rec'd within the three schools targeted for initial trials. Two aspects are important here—to establish the cost versus woodfuel, and to work out the requirements for the conversion of wood-fired stoves to charcoal. The latter is relevant in the few cases where the potential customer is using one of the more advanced designs (read "expensive" and "efficient") of wood-fired cookers. These newer stoves may be better left alone. I might start work on a design specifically for VWB soon.

From the contacts made to date, I'm surprised that many rather "upmarket" boarding and day schools here in Kenya cook over wood fires. All of the more inexpensive schools use wood. Kitchens are filled with smoke from primitive, often chimney-less stoves. Cooks and

Charcoal v. Fuelwood in Kenya

- Charcoal doesn't degrade over time or with exposure to rain. It is clean-burning, easily handled, and very controllable fuel, with associated urban prestige.
- Transport costs to urban areas from an ever-increasing fuelwood-harvest radius favor charcoal.
- Charcoal is more energy-dense. For equal volumes of charcoal and wood, charcoal contains 2.4 times more caloric value than wood. But manufacturing 100 kg of charcoal requires 300–400 kg of dried fuelwood.
- The demand for charcoal in Kenya is primarily in urban areas. —Elk

Briquetting Equipment: Locally made in Kenya, Elsen Karstad's charcoal briquetting equipment essentially scales up a meat mincer to process waste charcoal. It is powered by a 7-hp three-phase electric motor. Photo at www.ikweb.com/enuff/public_html/Bluemax.htm.

their helpers have chronic eye problems and, most probably, frequent respiratory complaints ...not very hygienic....Needless to say, it's the cooks who are the most enthusiastic proponents of a switch to charcoal.

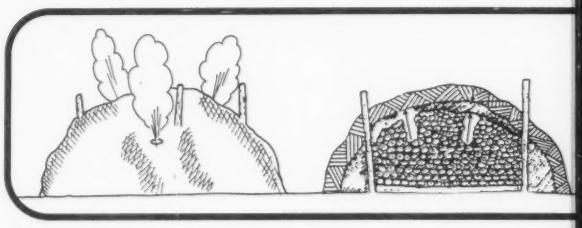
The logistics of using firewood are surprisingly complex and discouraging considering the extent of use. Trucks have to be hired to travel up to fifty km out of Nairobi in order to access reasonably inexpensive wood (all of it is purchased, it appears; the day of collecting free windfalls is over), and the often large tough (like Eucalyptus) stumps and logs must be hand split. Moisture is a big problem (compounded during the wet seasons), as dried wood is rare and the rate of consumption at the average-sized boarding school housing up to 800 children precludes storage long enough to dry the wood. More smoke and difficult ignition.

The characteristics of my Vendors Waste Briquettes are admirably suited to this sort of institutional cooking. They are as easy, if not easier, to light than wood in the common stoves (big round drums that support a pot of up to fifty liters—13.2 gallons—capacity); are virtually smokeless (less smoke than from regular lump charcoal); and burn over twice as long as normal charcoal—up to four times longer than an equal weight of wood.

As beans (served up in various recipes) are a staple part of the diet, the long burning time of VWB is well appreciated. Once the main course is cooked, the residual heat is sufficient to bring tea to a boil or heat water for washing up. As I have mentioned, the economics of VWB use has not been worked out yet, but I suspect that all costs considered, it'll be only very slightly more expensive than wood. The ease of use, health benefits, prestige, and lack of seasonal-only availability and quality fluctuation should certainly tip the scales in favor of VWB.

Charcoal contains less than 60 percent of the energy of the same weight of dry wood. I would not want to encourage the increased use of charcoal, because its manufacture requires cutting so much new fuelwood. But by selling reclaimed charcoal for considerably less than the cost of the standard wood charcoal (our Vendors Waste Briquettes are half the price), I hope to replace some of the existing market for wood charcoal, rather than stimulating charcoal demand overall.

In short, I am not concerned that this campaign will encourage the switch from firewood to charcoal in general. The HUGE reserves of waste charcoal powder (pure carbon) in and around Nairobi haven't been affected in the smallest degree by my offtake of two tons/day. It'll be a while before I can keep abreast of the inflow—which I calculate to be in the order of thirty tons per day. Environmentally I still stand on the high ground.



Charcoal-making oven. Cross-section of stacked virgin wood with air tubes; covered by mud to seal out air and burn slowly.

From the progress to date, I reckon I'll have proven the economics of this process very soon. I'm beginning to have more frequent visitors to see the VWB being made—a couple from Tanzania are due today, and last week I gave a tour and lectured to a group of local fourth-year university students (Forestry Products Program)—so the word is spreading. I reckon I've saved a few trees so far—aiming for my first forest now!

—***Elk*** (Elsen L. Karstad, PO Box 24371, Nairobi, Kenya. tel/fax (+254 2) 884437, elk@net2oooke.com.)

• Fuelwood provides domestic heating and cooking for nearly half the world's population. More than two billion people have no contact with the fossil-fuel economy.

• Petroleum substitutes for fuelwood in the US, Japan, and Europe saved more forest than any other intervention. Imagine the World Bank and IMF, in cities of poorer nations, helping to lower the price of butane, propane, and natural gas to just below firewood. Or a corporation offering stoves and lamps at reduced costs to create a permanent market. Fuelwood and charcoal, major driving forces reducing forests, biodiversity, browse, and carbon-sequestering, could be reined in with one event. —PW

Charcoal Access

CHARCOAL PRODUCTION
A Handbook

A.C. Hollingdale, R. Krishnan, and A.P. Robinson. 1999 (second ed.); 158 pp. £14.95 (£18.45 postpaid) (US$27/30). Commonwealth Science Council. eco-logic books, 10/12 Picton Street, Bristol BS6 5QA, United Kingdom. +44(117) 942 0165, books@eco-logic.demon.co.uk. (Suggested by Elk.)

Comprehensive, accessible information on all aspects of charcoal production. Transformation of biomass to charcoal; traditional, brick, and transportable metal kilns, briquetting; charcoal analysis; gas production; use as a cooking fuel.

(You can find directions for making your own charcoal at www.eaglequest.com/~bbq/charcoal/index.html. —Daphne Derven)

Hands-On Fire-Crafting

Out of the campfire evolved the stove, the furnace, and the kiln, and from cooking came the technologies of ceramics and metallurgy. Glass, glaze, enamel, bricks, clay linings for irrigation ditches and pipes, plaster and cement, pottery, and artifacts of tin, copper, bronze, gold, silver, and iron all enriched and reshaped human life, not only by society's direct absorption but indirectly by redefining what natural materials were valuable. Deposits of good clay became as valuable as caches of chert in Paleolithic times; copper lodes loomed as critical as prime soils....

...Fire quarrying sank tunnels through soil, permafrost, and rock; candles and lanterns illuminated underground shafts for miners; the assayer's flame determined the character of prospective lodes; hot fires roasted raw ore and sustained its laborious smelting into metal; furnaces allowed casting into axes, knives, picks, coins, cannons, bells, jewelry. Without the concentrated power of fire, peoples had to rely on opportunistic foraging, on exposed veins of native copper, placered nuggets of gold, iron meterorites. With fire, however, they could literally force open the earth for raw material, forge new tools, and redefine their relationship to the landscape--to the biosphere as well as to the lithosphere, because fire required fuel and the prodigious fires of great mines required equally immense mountains of fuelwood. —Vestal Fire, *Steven J. Pyne* *(see page 14)*

Fire-Craft Timeline

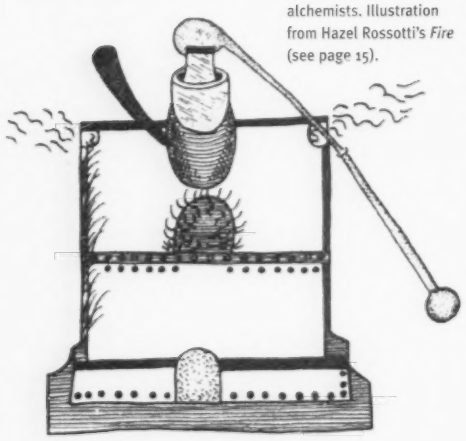
12,000 B.C.E.	*First known vitreous glaze over beads.*
10,000 B.C.E.	*Pottery vessels first found in Japan.*
7,000 B.C.E.	*First whole glass amulet.*
6,300 B.C.E.	*First known fire-hollowed dugout canoes.*
5,000–3,000 B.C.E.	*Coppersmiths extract copper from rocks using fire.*
4,000–3,000 B.C.E.	*First known fired brick ovens.*
2,000 B.C.E.	*Earliest known brand for livestock. Early bronze metallurgy.*
400 B.C.E.	*Beginnings of Chinese alchemy and distillation.*
10th century B.C.E.	*Carbonized iron (the first steel).*
1200–500 B.C.E.	*Iron replaces bronze. Japan and China perfect ceramic pots and lacquerware.*
800–100 C.E.	*China makes porcelain.*
1540 C.E.	*Vannoccio Biringuccio's* The Pirotechnia, *first metallurgy text.*

The alchemist, like the smith, and like the potter before him, is a "master of fire." It is with fire that he controls the passage of matter from one state to another. The first potter who, with the aid of live embers, was successful in hardening those shapes which he had given to his clay, must have felt the intoxication of the demiurge: he had discovered a transmuting agent. That which natural heat—from the sun or the bowels of the earth—took so long to ripen, was transformed by fire at a speed hitherto undreamed of. This demiurgic enthusiasm springs from that obscure presentiment that the great secret lay in discovering how to "perform" faster than Nature, in other words (since it is always necessary to talk in terms of the spiritual experience of primitive man) how, without peril, to interfere in the processes of the cosmic forces. Fire turned out to be the means by which man could "execute" faster, but it could also do something other than what already existed in Nature....

...All [the alchemist, the smelter, the smith], by aiding the work of Nature, accelerated the tempo of things and, in the final instance, were substitutes for Time itself.

—*The Forge and the Crucible* (see access)

Classic Fire-Crafts



Distiller used by medieval alchemists. Illustration from Hazel Rossotti's *Fire* (see page 15).

The Forge and the Crucible
The Origins and Structures of Alchemy

Mircea Eliade. 1979 (2nd ed.); 238 pp. $15. University of Chicago Press.

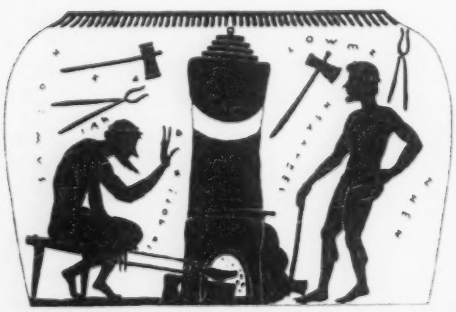
Start here. The classic on Europe. For China, see Volume 5 of Joseph Needham's *Science & Civilization in China* (Cambridge University Press).

The Complete Modern Blacksmith
Alexander G. Weygers. 1997; 300 pp. $19.95. Ten Speed Press.

The blacksmith's bible. (See *Whole Earth*, Summer 1999, page 112.)

Work Methods & Tools of the Artist-Blacksmith (Werk und Werkzeug des Kuntschmieds)
Otto Schmirler. 1993 (revised ed.); 128 pp. $51. (Verlag Ernst Wasmuth) Centaur Forge Ltd., PO Box 340, Burlington, WI 53105. 800/666-9175, 414/763-9175, centforge1@aol.com, www.centaurforge.com.

An extremely popular how-to book; over 600 tools and techniques for the artist-blacksmith, with over 300 illustrations.

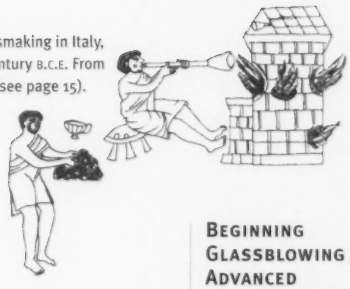


Greek vase, 6th century B.C.E. From *Fire* (see page 15).

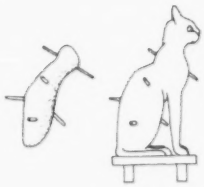
New Edge of the Anvil
A Resource Book for the Blacksmith

Jack Andrews. 1994 (revised ed.); 256 pp. $25. Skipjack Press.

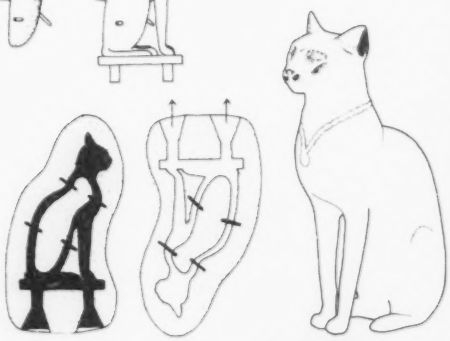
An updated classic. Very very practical.



Glassmaking in Italy, 11 century B.C.E. From *Fire* (see page 15).



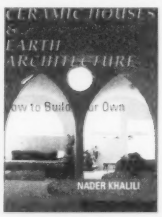
Lost-wax method. From *Fire* (see page 15).



The Kiln Book
Materials, Specifications & Construction

Frederick L. Olsen. 1983 (2nd ed.); 291 pp. $40. Krause Publications.

Egyptian kiln, 3500 B.C.E. From *Fire* (see page 15).



Ceramic Houses & Earth Architecture
How to Build Your Own

Nader Khalili. 1986; 223 pp. $19.95 ($24.95 postpaid). Cal-Earth Press, 10376 Shangri La Avenue, Hesperia, CA 92345. 760/244-2201, www.calearth.org.

These ceramic houses, fired from the inside out, become their own kilns. (See *Whole Earth*, Summer 1999, page 113.)

Oil lamp, from *Lengthening the Day* (see right).

Beginning Glassblowing and Advanced Glassblowing Techniques
Both by Edward T. Schmid. 1998; 120 pp. $24.95 and 320 pp. $32.95 respectively. Glass Mountain Press, 927 Yew Street, Bellingham, WA 98226, 360/733-3497.

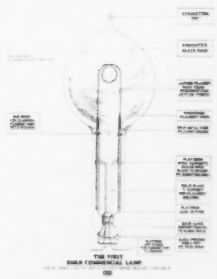
Glass Notes
A Reference for the Glass Artist

Henry Halem. 1996 (3rd ed.); 291 pp. $30 ($35 postpaid). Franklin Mills Press, PO Box 906, Kent, OH 44240. 330/673-8632, www.glassnotes.com.

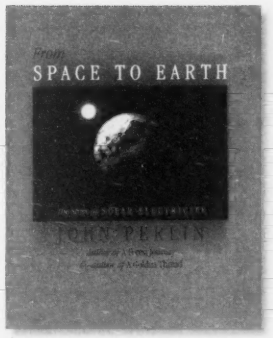
Lengthening The Day
A History of Lighting Technology

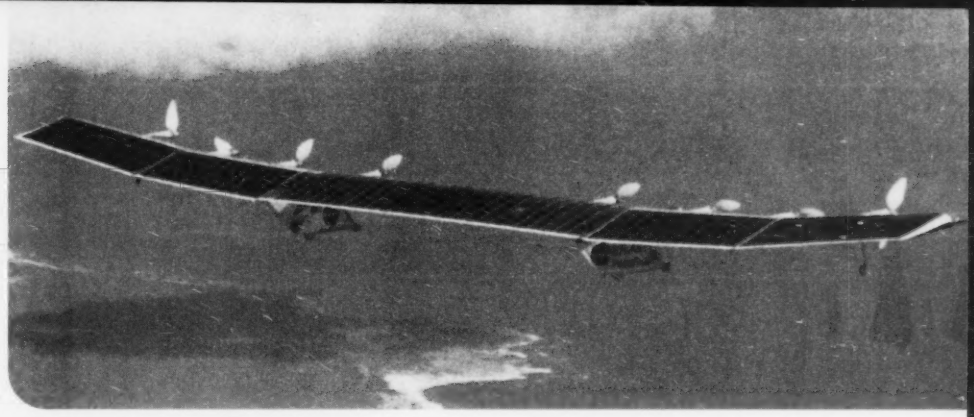
Brian Bowers. 1998; 221 pp. $45. Oxford University Press.

The only, the brightest. Fire to fluorescents.



Assembled with generous assistance from blacksmith Jeffrey Jelenfy, of Ironwood Forge in Clinton, Maryland.





From Space to Earth
The Story of Solar Electricity

John Perlin. 1999; 224 pp. $32.
aatec publications.

John Perlin's delightful historical tour through the development of photovoltaics (PV) answers not only the question of what is new under the sun, but most importantly, how we got here. Perlin charts the evolution of the photovoltaic industry from its beginnings in early industrial semiconductor and materials-science research in the 1950s to the present. In 1955, for instance, the cost of solar cells was over $150 per kilowatt-hour (or, by one estimate, over 1.5 million dollars to electrify a standard suburban house); non-solar energy cost was 1–2 cents per kilowatt-hour. Solar is now below 25 cents and, with deregulation, the price of other sources is up.

An important aspect of *From Space to Earth* is Perlin's clear presentation of one of the "ah-ha," or epiphany, phases of photovoltaic evolution: the change in thinking about energy from a centralized to a distributed resource. Initially, efforts to greatly expand the role of photovoltaics in the energy market focused on large solar arrays that could provide power to utilities. This works fine technically, but fails to take advantage of photovoltaics' ability to be placed here and there—wherever needed. Perlin describes the heroic efforts by a number of solar pioneers to identify and implement solar cells for decentralized "niche" markets ranging from calculators to railroad warning lights to microwave relay stations to isolated call-boxes. Utilities began to shift their thinking to small rooftop solar systems for buildings—and, critically, for homes. Utilities in the US and Europe slowly began to see the potential for truly decentralized energy sources (something that has accelerated under the ongoing deregulation of utilities), and equally important, the evolution of the market for solar home systems in developing nations.

***From Space to Earth* leads the reader through an engaging abundance of historical details, fascinating photographs, and PV advertisements. It's not a place to learn about the details of the technical or economic evolution of photovoltaics; it's the best and most readable book on the social history of photovoltaics research, policy, and market growth. —Daniel M. Kammen**

"The urgent demand for solar cells above the earth opened an unexpected and relatively large business for the companies manufacturing them. "On their own commercially, they wouldn't have gotten anyplace," observed the late Dr. Joseph Loferski, who spent his life working in photovolatics. But locked into the space race with the Russians, the American government poured more than fifty million dollars into solar cell research and development from 1958 to 1969. "For the first time in the long history of solar energy research," the late John Yellot observed, "relatively large amounts of government funds are being assigned to projects which will lead to the building of...reliable solar power devices." Indeed, as Martin Wolf contends, "The onset of the Space Age [was] the salvation of the solar cell industry."

"Some [people] move to the cities in order to have [such] conveniences [as TV and good lighting]. Others, however, such as Joseph Omokambo, a Kenyan civil servant, have stayed put but still manage to enjoy TV. Though not connected to a power line, Omokambo found that he could get the electricity he needed by hooking a car battery to his television set. Once or more a week, depending on how much TV he watched, the battery would run out. Recharging meant lugging the battery three or so miles (five kilometers) to town and leaving it overnight with an enterprising townsman who had electricity and who had set up a makeshift charging station in his garage. Omokambo would return the next morning, pay the man about $2, and carry the battery home. As time went on and the battery wore down, the trips became more frequent....Then he learned from friends that there was a way he could keep his battery charged at home. Solar Shamba, they told him, sold a gadget that when placed on the roof produced electricity.

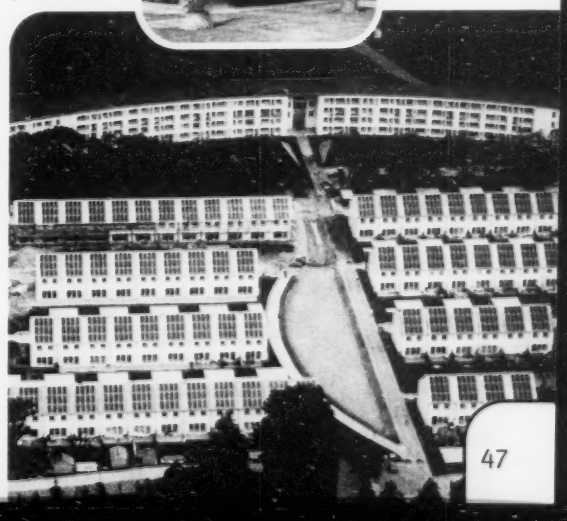
"A very small module has come to dominate the market. Rated at only twelve watts, and priced at about $80 U.S., it is affordable for many Kenyans. Over ten thousand twelve-watt units have been purchased each year since 1994. The mini-module kit is sold alongside televisions and radios, because "shopkeepers have realized that if people buy a TV, they need something to power it."

"The number of potentially inexpensive ways to make solar cells being pursued is dazzling. They include sheet crystalline silicon, amorphous silicon, thin crystalline silicon, cadmium telluride, and copper indium diselenide. Even traditional crystalline silicon might surprise the pundits. It still has the potential to drop significantly in price. Only time will tell which material will dominate.

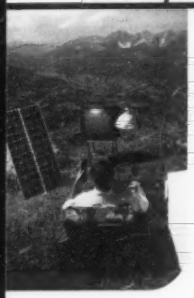
Above: Ultra-high, slow, and long-lasting: AeroVironment's prototype of a solar-powered aircraft that could monitor the development of potentially destructive weather events.

Right: A "fare," or thatched-roof Polynesian home, outfitted with photovoltaics.

Below: An apartment complex in Bremen, participating in Germany's "one hundred thousand-roof" photovoltaic program.



Tapping the Sun



by Joe Schwartz

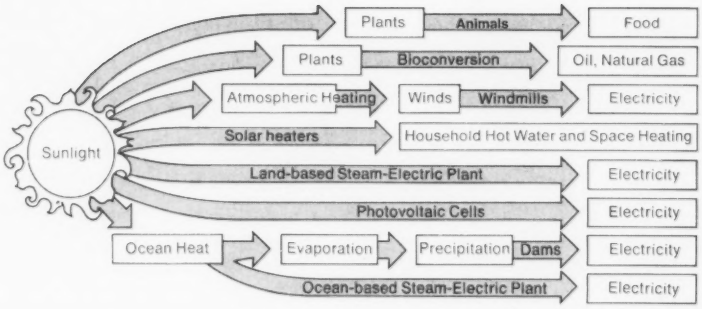
Joe Schwartz is associate editor of *Home Power* magazine (page 49), which kindly supplied equipment photos.

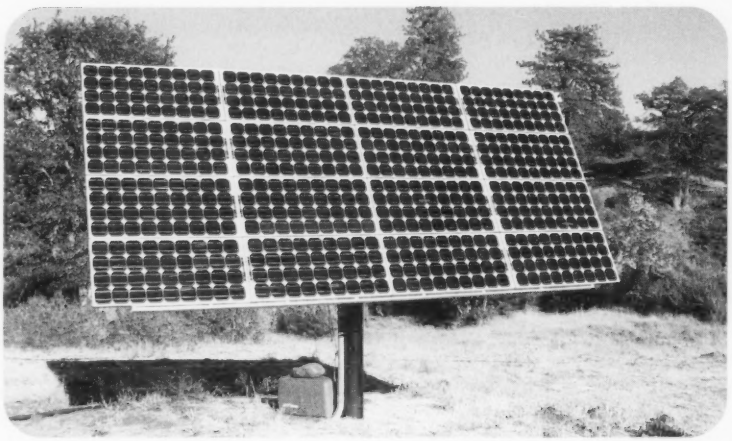
The sun is the ultimate energy resource. It drives all life processes on earth. With the help of solar collectors, humans are gradually reacquainting themselves with this fact. Solar photovoltaic modules produce electricity from sunlight. Solar thermal collectors make hot water. Using solar energy is a practical way to offset our dependence on fossil fuels. Solar technology is ready for the mainstream energy markets now. In most locations off the utility grid, a professionally installed PV (photovoltaic) system is less expensive than a 1/8-mile utility line extension.

If federal subsidies that artificially support coal, nuclear, and large-scale hydroelectric generation could magically disappear, photovoltaics would be economically competitive immediately. Today, people who live on the grid and invest money in a PV system are making a great ecological statement and a lousy financial one. But think about it: people make "lousy" financial decisions all the time. Do I actually need a $30,000, four-wheel-drive sport-utility vehicle to run errands around town? Or how about spending $20,000 on remodeling my kitchen? Are these lousy financial decisions? People place different values on different things. The great news is that more and more people are investing in a clean energy future that only the sun can provide.

Below: A caravan carrying PV panels arrives at the Indian city of Jaisalmer.

MANDANJEET SINGH





PHOTOVOLTAICS

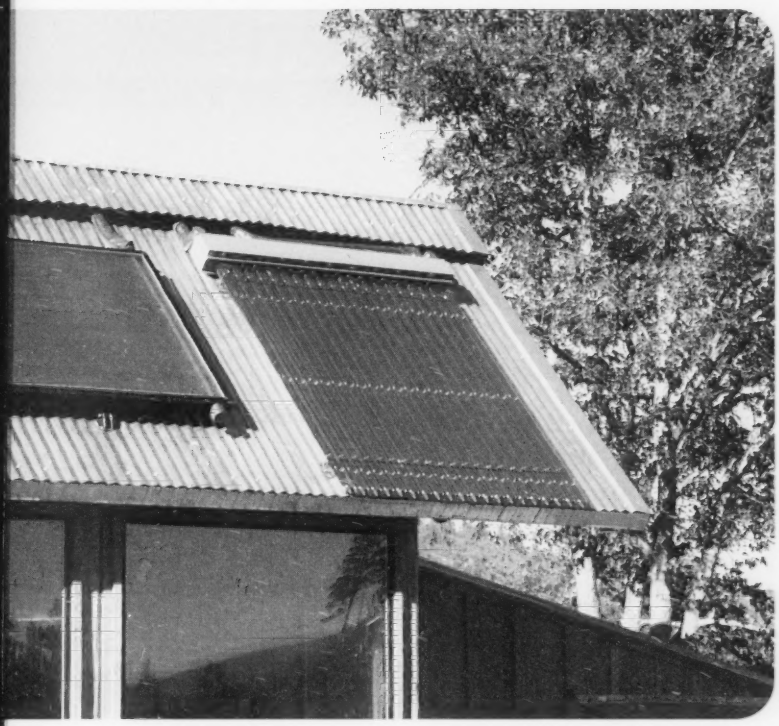
PV modules are the most high-tech and perhaps the most elegant way to harness the power of the sun. PVs convert the sun's energy into a DC electron flow. Inverters then condition the module's output, creating standard 120- or 240-volt AC electricity used by household appliances. Many inverters can also synchronize their output with the utility grid and actually spin your electric meter backwards. This way, you can share clean, renewable energy with your neighbors.

PV modules have steadily grown in size, output, and efficiency. A typical module output is now 75–100 watts per panel; two by four or five feet in area. In less than two years, in a sunny location, a PV module can produce output equivalent to all the energy it took to manufacture it. PVs have no moving parts to wear out, require no maintenance (except in dusty climates where they must be cleaned off regularly), and can carry warranties of twenty to twenty-five years. Since PVs don't make electricity from heat and production actually drops with temperature, they are best placed on a tracking pole, not on the roof.

Most PV modules end up in "Is the Ford better than the Chevy?"-type arguments. Pay attention to cost per watt of power produced, and the length of the module's warranty. Up at *Home Power*, we recently had our first PV failure in nearly two decades. The nine-year-old module was simply returned to the manufacturer, who replaced it with a new one.

The BP590 module by BP Solar and the SR100 module by Siemens Solar are the two leading single-crystal PVs. The BP590 is an 85-watt module with a twenty-year warranty. It converts 17 percent of the sun's energy into electricity—the most efficient PV you can buy. The Siemens SR100 is a 100-watt module, meticulously constructed. Its twenty-five-year warranty is the longest in the industry.

Because batteries have not changed much for half a century, they remain the dinosaur in the PV system. [In the boonies, the battery house replaces the outhouse and, emissions aside, it's a toss-up whether a diesel generator is more convenient than a shed full of batteries —*Ed.*] PVs are most convenient with grid-connected homes. Here, batteryless inverters allow a post-modern fusion of old utilities with the new. —JS



Solar Hot Water Systems

Solar thermal (hot water) systems are a simple way to use the sun's energy in your home. A roof is hot, and is the ideal location to heat hot water for appliances and space heaters. Solar systems are typically used in conjunction with standard gas or electric water heaters, reducing the amount of fossil fuel required to keep you in hot water. They have two- to five-year warranties.

Several systems and products are available. In colder climates, closed-loop systems rely on freeze-proof glycol as the heat transfer fluid. These systems eliminate freeze damage to collectors or plumbing. In warmer climates, drain-back systems directly heat the water that is used inside the house.

Two types of solar collectors are available: evacuated-tube and flat-plate. In southern Oregon, at *Home Power*, we run both side by side. In cold climates, the evacuated-tube collectors manufactured by Thermomax are the most efficient. Thermomax utilizes evacuated tubes to transfer the sun's heat to a closed glycol loop. Twenty- and thirty-tube units are available, and their appearance is as high-tech as their function. Flat-plate collectors, manufactured by Sunearth, are a less expensive and comparable alternative. In warm climates, flat-plate collectors can produce 90–100 percent of the hot water that evacuated-tube units can, for less than half the cost. —JS

Solar Cooking

Solar cookers do not couple well with the standard 9-to-5 "Honey will you microwave me some dinner?" lifestyle. [Even in "less developed" nations, women cannot get the roasted taste, the sanctity of the hearth, the double function of both heat and light, or the cloudy-day reliability that wood fires provide. —*Ed.*] Solar cooking can be fun and a small environmental statement, like riding your bike to work. These ovens use reflectors to focus the sun's energy and heat food. Solar Chef ovens can reach 500°F, and provide real-time cooking in full sun. A less costly and solid-performing alternative is the Global Sun Oven manufactured by Sun Ovens International. —JS

Left: Thermomax evacuated-tube collectors.

Below: Solar Chef oven and reflector.

Solar Access

BP Solar
888/274-7652
www.bpsolar.com

Siemens
800/947-6527
www.siemenssolar.com

Thermomax
410/997-0778
www.thermomax.com

Sunearth
800/978-6327

Solar Chef
800/378-4189
www.solarchef.com

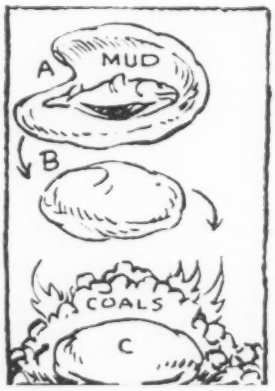
Sun Ovens International
800/408-7919
www.sunovens.com

Home Power
Richard and Karen Perez, eds. $22.50/year (6 issues). PO Box 520, Ashland, OR 97520. 800/707-6585, 541/512-0201, hp@homepower.com, www.homepower.com.

For more years than I can remember, *Home Power* magazine has been the best place to go for advice on what works and what doesn't in providing (and using) your own electricity. The articles and reviews are clear even to newcomers. Product reviewers include users' experiences even when they discredit an item advertised in the magazine. How does *Home Power* get away with that? It is to the advertisers' advantage to recognize the flaws found by users in the field and correct them. Now that's trust. I've used information from those good folks many times, and never gone wrong.
—J. Baldwin

The Raw and the Cooked

Before cooking, food was eaten raw, decayed, and putrefied. The human discovery of roasting remains unattributed, though Charles Lamb wrongly glamorized the story of the Chinese boy who accidently burned down his hog shed and, in trying to save a well-barbecued piglet, discovered the glory of crackling. *Raw*, as anthro Claude Lévi-Strauss insisted, became a synonym for crude, imperfect, wild; *cooked* was refined and tasteful, beneficial and necessary for human work, family, and culture. Perhaps as long ago as 500,000 years, fire-cooking—and with it, that potent metaphor in the human mind —blossomed.



From *Wildwood Wisdom* (see page 42).

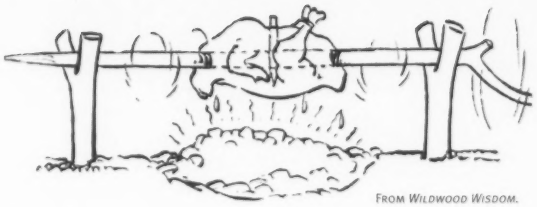
With applied heat, the whole concept of food transmuted. Toxic and inedible roots became edible when baked; indigestible and unchewable parts of game became prized giblets. Anthropologists estimate that hunter-gatherer cooking doubled the kilocalories consumed per day (from 2,000 to 5,000) and may have subtly changed our genetic constitution; better-nourished consumers of cooked food produced more offspring.

At some unknown time our ancestors discovered that smoking preserved food more thoroughly than sun and wind, and steaming cooked the meat more thoroughly than charring the outside and leaving the inside blood blue. Smoking took the edge off seasonal starvation; humans could stash their jerky and explore with greater freedom. But the evolution of roasting and smoking into boiling, baking, and frying would require a new vision of humans as keepers and tenders of new utensils and controlled flames. —PW

Cooking with Fire

by Daphne Derven

I think we began doing it because cooking improved flavor. Browning meat over an open fire makes flavors intense and sweet. Steaming, such as by wrapping food in clay (tandoori) or wet leaves, contains the moisture, preserves the delicacy of flavor and foods' wonderful texture. (It receives the attention it deserves in the Asian kitchen; only in America is it looked upon as "simple.")

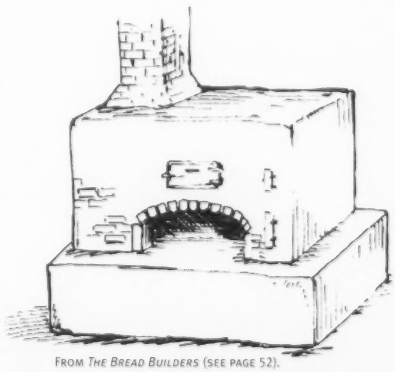

From *Wildwood Wisdom*.

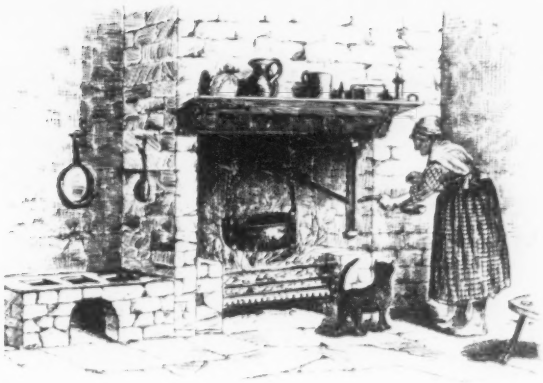
Early cooking took place over the open fire, using what was at hand. Sticks, ashes, smoke, leaves, stones. Spits and pits. Only later, containers were used to cook food with fire. When wicker baskets could hold water, cooks could boil food by dropping hot stones into the water until it bubbled. After the invention of ceramics, cooks could boil and stew in pots right in the open fire.

From *Wildwood Wisdom*.

5,000 years ago: The people of Ur (ancient Sumeria) were cooking bread in ovens. They burned simple fuels in the oven, then swept out the ashes and put the bread in; it baked in re-radiated heat from the oven walls. Much of the process of obtaining food, building a fire, and cooking remained the same, passed from generation to generation.

About 600 B.C.E.: Leviticus hints that pan frying (the use of vegetable oil to cook food) had been invented, complementing the styles of roasting/grilling, steaming/boiling, and baking.


From *The Bread Builders* (see page 52).

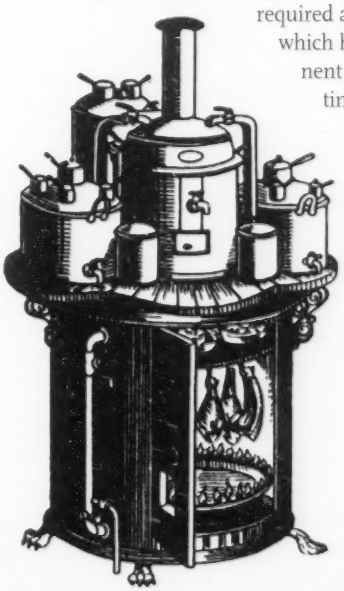


Frying would not become truly popular until the cast-iron pan.

About 300 years ago: A radical shift in iron technology; by the 1700s, cast iron (iron made with about 3 percent carbon) was used for stoves in Central Europe, but still primarily for heat, not cooking. Cooking remained separate in cast-iron troughs covered with grills fed by coal and charcoal, which replaced wood.

By 1802: Odorless natural gas joined wood and coal. It changed the taste and smell of meals. It powered the iron stove. The fuels for the flame became invisible, and, by the end of the century, would begin to disappear altogether.

By 1815: Home heating and cooking began to seriously merge. An iron cookstove was patented and in production, along with other stoves described as "suitable for families and ships." (We forget that up to this point, cooking at sea also required an open hearth.) Fire, which had been a prominent part of the daily routine for thousands of years, was being enclosed and controlled. The direct and visible connection to the flame was disappearing, and the hearth, the heart of the home, was slowly vanishing.



By the 1860s: The fundamental way to cook, roasting by an open fire and baking on the floor of the oven (no pans), disappeared. Many complained bitterly about the loss of good crust on their bread, and how meat was not really roasted, but steamed, by the new stoves. It made no difference to the relentless progress in cooking methods.

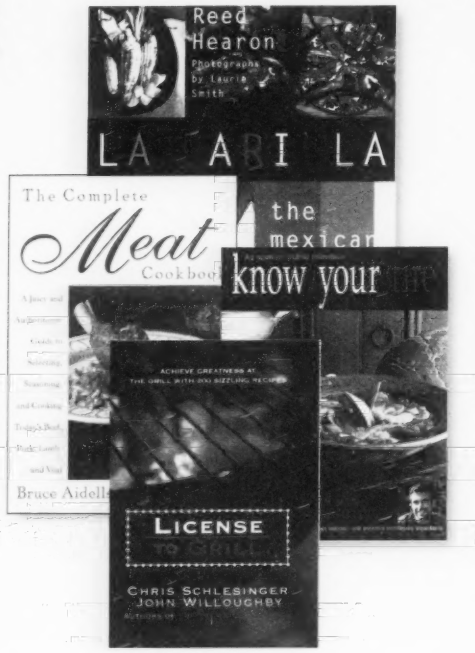
The turn of the century: Just as gas and coal cooking ranges became common, the electric range appeared (featured in the 1893 Columbian Exposition in Chicago), followed by canned soup and electric hot plates. By the 1920s, natural-gas and electric stoves were widely adopted for home use. In a radical move, stoves became white, a dramatic change from the black iron stove and sooty fireplaces, more modern and sanitary.

1946: In perhaps the most dramatic moment in cooking history since the first cooked meal, Percy Le Baron Spencer invented the microwave oven, which cooked food without a direct source of heat. In 1967, a compact version was sold for home use. Today, the majority of American homes have microwave ovens and our connection with cooking fire has been severed. While fire still remains for some of us in our backyard barbecues, many people today have no experience building a fire (and many barbecues have propane starters).

In tribute to our ancestors, and the millions of meals that have been cooked with fire, I recommend the books on the following page.

Fire-Cooking Access

For a virtual experience with fire and cooking, go to the Web sites of the Masonry Heater Association of North America (http://mha-net.org/index.htm) and the Brick Bake Oven Page (http://mha-net.org/msb/html/bakeoven.htm). —DD



La Parilla
The Mexican Grill
Reed Hearon. 1996; 131 pp. $19.95. Chronicle Books.

Know Your Fire
George Hirsch with Marie Bianco. 1997; 306 pp. $16.95. HP Books.

License to Grill
Chris Schlesinger and John Willoughby. 1997; 400 pp. $27.50. William Morrow and Company.

The Complete Meat Cookbook
A Juicy and Authoritative Guide to Selecting, Seasoning, and Cooking Today's Beef, Pork, Lamb, and Veal
Bruce Aidells and Denis Kelly. 1998; 604 pp. $35. Houghton Mifflin.

There are lots of books which deal with grilling and barbecuing; these four are my current favorites. All have a range of dishes and clear directions. Reed Hearon's *La Parilla* is my personal favorite, with some wonderful pictures of people, food, and fire. Its recipes are a bit more complex than those in the others. Try the Duck and Pomegranate Tacos, easy and unforgettable, and do the whole finger thing with the Grilled Corn on the Cob with Chipotle Rub and Lime. *Know Your Fire* is a more basic book, with a lot of background information on how to use heat and fire along with the recipes. *License to Grill* is fun and fairly easy. I liked the Grilled Scallop-Stuffed Avocados with Papaya Vinaigrette and Sweet-Spicy Barbecued Spareribs with Green Chile Sauce. *The Complete Meat Cookbook* is one of those fundamental reference books that the meat eaters among you can't do without. Try the many hamburger variations or anything else...all are delicious. —DD

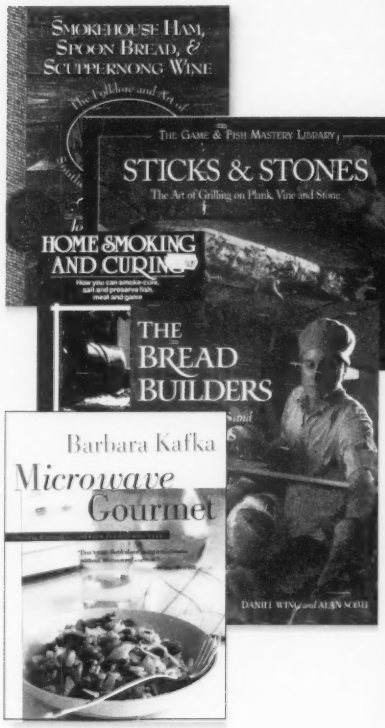
Smokehouse Ham, Spoon Bread, & Scuppernong Wine
The Folklore and Art of Southern Appalachian Cooking
Joseph E. Dabney. 1998; 493 pp. $19.95. Cumberland House.

Sticks & Stones
The Art of Grilling on Plank, Vine and Stone
Ted Reader and Kathleen Sloan. 1999; 96 pp. $19.50. Willow Creek Press.

Home Smoking and Curing
How You Can Smoke-Cure, Salt and Preserve Fish, Meat and Game
Keith Erlandson. 1997 (reprint ed.); 120 pp. £7.99. Ebury Press, Random House, 20 Vauxhall Bridge Road, London, SW1V 2SA, United Kingdom.

The Bread Builders
Hearth Loaves and Masonry Ovens
Daniel Wing and Alan Scott. 1999; 253 pp. $35. Chelsea Green.

Microwave Gourmet
The Only Microwave Cookbook You Will Ever Need
Barbara Kafka. 1998; 576 pp. $16. William Morrow and Company.


Smokehouse Ham, Spoon Bread, & Scuppernong Wine
The Folklore and Art of
The Game & Fish Mastery Library
STICKS & STONES
The Art of Grilling on Plank, Vine and Stone
HOME SMOKING AND CURING
THE BREAD BUILDERS
Barbara Kafka
Microwave Gourmet
DANIEL WING and ALAN SCOTT

This next group of books is for the more primal among us. Although Joseph Dabney's *Smokehouse Ham, Spoon Bread & Scuppernong Wine* is a cookbook, it also celebrates life in Appalachia. Read it just for pleasure—the images and quotations comprise a virtual Appalachian tour—but, if possible, cook from it and reconnect. My favorite part is the Brunswick Stew section: "When you get away from a cast-iron pot and firing with wood, you've done got away from the Brunswick stew business."

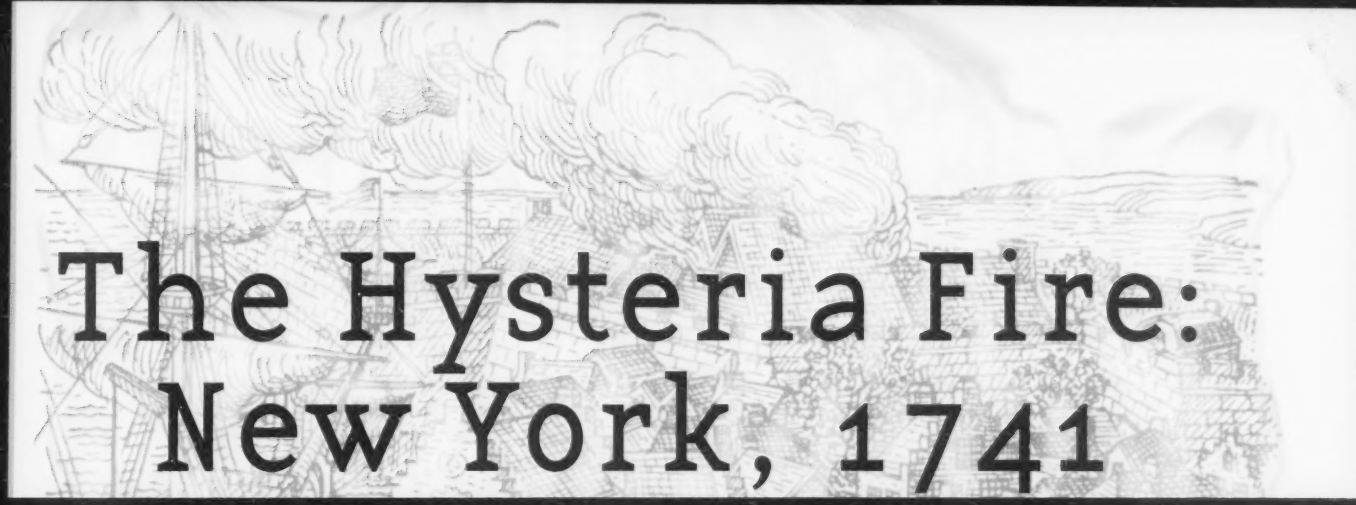
Stones, vines, and smoke are all part of the old ways. Try plank roasting. It's easy and the results will amaze you. In *Sticks & Stones*, I was impressed by the cedar-planked Onion and Portobello Mushroom Focaccia, Planked Chicken with Herbs and Old Cheddar, and Bourbon and Honey-Planked Pears with Mascarpone Fool. *Home Smoking and Curing* is very intense, a step-by-step type of book about lost culinary arts that once we lived by. It's the book by which to reconnect with your roots and be prepared for whatever Y2K throws at you.

The Bread Builders takes us back to the fundamentals: bread and fire. How to capture and tame your own yeast. Five chapters devoted to the history of ovens, how to build them, and how to use them. It doesn't really matter whether you intend to build your own oven or not. The discussion of how to control the fire—and therefore the temperature of ovens—radiates thousands of years of fundamental human history. Peek in the oven. This book illuminates your daily bread.

Normally a book like *Microwave Gourmet* would make me nervous. Any self-styled "the only book" is usually not. In this case, however, it is true. The introduction gives a good and clear description of how the microwave "cooks" and how different foods are affected. The recipes go well beyond melting chocolate and defrosting frozen-food basics, to dishes like risotto, jams, and soups. If you have a microwave, you should have this book. —DD

"Barbecue, country ham, and grits all spring from Indian methods of preserving meat and corn by fire without the aid of salt. 'For preservation, a barbecue is erected,' a European traveler to the South wrote in the early nineteenth century, 'and the fish are smoked over a fire.' Since the discovery of salt, Europeans had preserved foods by pickling them in brine, but there were men who 'barbecued' their game and fish by dehydrating them with mere smoke.

Smoke did for the Southeastern tribes like the Catawbas and Cherokees and Creeks what the sun did for the tribes of the Southwest. A gathering of men around a raised platform of saplings above a fire pit to smoke the day's catch was a social occasion celebrating the gift of fire by which man tamed the wilderness and turned raw food to cooked before it rotted."
—Smokehouse Ham, Spoon Bread, & Scuppernong Wine



The Hysteria Fire: New York, 1741

Slavery, Sex, and "Popery" Ignite Witch-Hunts, Torture, and Hangings

by John V. Morris

On March 18, 1741, fire took command in Manhattan and, whipped by a strong wind, swept through Fort George on the Battery. It started in the roof of his majesty's house, the residence of Lieutenant Governor George Clark, who headed the colonial administration. New York's first firefighters, with the aid of all the citizens who had heard the alarm, ran with the two engines down to the fort. But the gale fanned the blaze beyond their control and many of the citizens, fearing gunpowder explosions, fled from the fort. The official residence burned to the ground and the flames spread to the chapel, the secretary's office, and the barracks, until everything within the walls of the fort was in ashes.

At first the lieutenant governor announced that the cause of the fire was due to a plumber who, while repairing a gutter on his majesty's house, had used a pan of live coals to keep his soldering iron hot, and the wind had blown some of the coals up underneath the shingles. But this logical, and probably true, explanation of the cause was soon pushed aside. An epidemic of fear gripped the city during the following six months.

The Salem witchcraft trials, fifty years before, were not a whit more cruel and stupid than the "New York Conspiracy" trials of 1741. They were based on racial hatred, which had been growing ever since 1628, when slaves were first shipped to New Amsterdam by the Dutch. The slave trade was a very profitable part of the Dutch West Indies Company, and it was carried on after the British took over. In 1709 a slave market was set up at the foot of Wall Street and a calaboose [local jail] was built on Park Commons. Nearly every upper-class family in New York owned at least one slave, and the greater the number of slaves, the higher the social position of the family. In 1718, the peak year of the slave trade in New York, 517 Negroes were shipped to that city, and by 1741, one fifth of the 10,000 inhabitants were slaves. They were mistreated, overworked, and severely punished for the slightest infraction of strict regulations, and could be put to death for committing a crime no greater than the theft of a few dollars' worth of "speckled linen." Two Negroes, Caesar and Prince, had been arrested for just that crime and were in jail awaiting their trial for life or death when the fire broke out at the fort.

For some time there had been great fear that a large number of the slaves in town might band together and seek revenge and freedom. To discourage such possibilities, the law provided for forty lashes on the back of each slave seen in a group of three or more. Before the ashes of the fire at the fort had cooled, some of the more impetuous citizens preferred to believe that the fort had been deliberately set afire by the slaves. The rumor whispered through the town as swiftly as the March wind, and the nightmare began.

On the following Wednesday, just one week after the fire at the fort, there was a small chimney fire at the home of Captain Warren, which was readily extinguished. But even though chimney fires were frequent, the rumormongers leaped at the opportunity to point out that there must be a plot amongst the slaves. Other fires followed during the next few weeks: a small fire in "the cow stables of Mr. Quick in the Fly" (East End of the city), another in Ben Thomas's kitchen, and several

Adapted from "The New York Conspiracy," in *Fires and Firefighters*, by John V. Morris. Bramhall House, 1955 (out of print). Illustrations on this and following page by the author.

more. The only fire of any size was in the storehouse of Mr. Van Zant, which he reported as having been caused by careless pipe smoking, "but the people exerted their usual diligence, and played the engines...with such extraordinary activity, it stopped the progress of the fire...with little more damage than the entire consumption of the warehouse and most of the goods in it."

By this time the evil rumors filled the town with terror. Whispers burst into shouts, "The Spanish Negroes! The Spanish Negroes!" (referring to the slaves who had recently arrived in New York from a Spanish ship captured by the British during their unsuccessful war with Spain). The magistrates at once ordered "all of that cargoe" rounded up and thrown into jail.

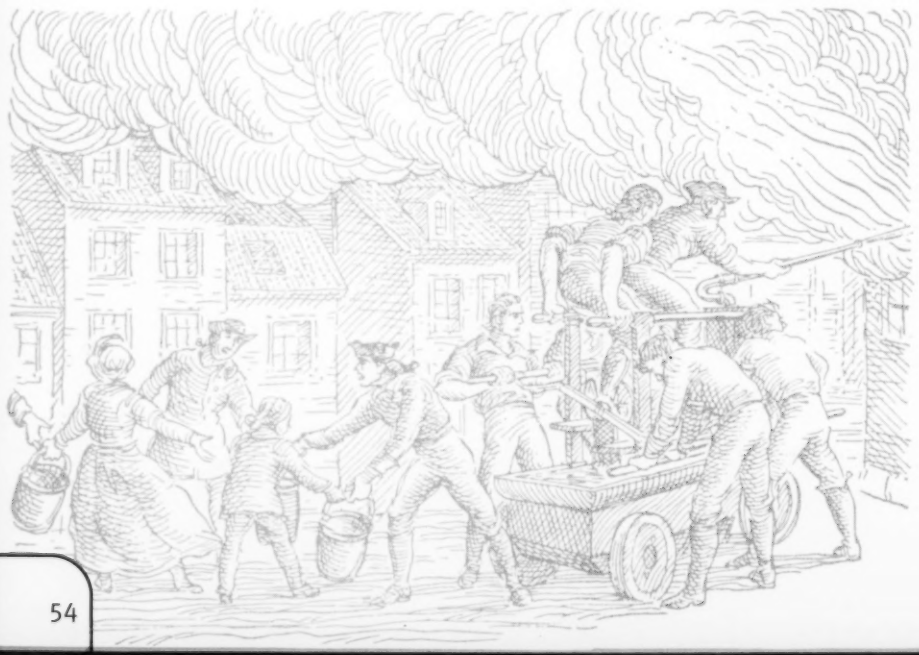
Two women reported that they had heard a Negro, Quaco, singing and strutting in the company of two other slaves: "Fire, Fire, Scorch, Scorch, A Little, damn it, By and By!" The Negroes were arrested and put to torture along with others suspected of conspiracy, and a long series of confusing confessions began to pour out by means of beatings, death threats, and false offers of freedom.

However, most of the convictions were finally clinched by the testimony of Mary Burton, a "Spinster, aged about sixteen years" who was an indentured servant of John Hughson, operator of a low rum joint by the North River waterfront; [by] Hughson's daughter Sarah, a simple and very superstitious girl who actually used the warnings and predictions of a fortuneteller as part of her court testimony, and who, with her mother, was accused of entertaining men, especially Negroes, at all times of the day and night; and [by] Peggy Kerry, a notorious "Newfoundland and Irish" prostitute who lived with the Hughsons and was mistress of Caesar, one of the slaves in jail for stealing the "speckled linen."

It was the testimony of Mary Burton that had brought about the arrest of Caesar and Prince. She then accused her master, John Hughson, as the one who had received the stolen linen and harbored the criminals. And when the lieutenant governor offered a hundred pounds reward to anyone who could reveal the person or persons "lately concern'd in Setting fire to any dwelling," Mary at once stepped forth and named the Hughsons, Peggy, Caesar, Prince, and eventually dozens of others, both slaves and whites, as conspirators in a great plot to burn down New York. Hughson, she said, was to be king, Caesar the governor, the slaves were to be free and wealthy, killing most of the white men and "taking the women unto themselves."

By the middle of April the prison filled to overflowing; the magistrates and justices were busy at court every day, indicting, convicting, and sentencing one after another in a maze of extraordinary testimony; and every house in Manhattan was thoroughly searched for hidden slaves or goods stolen from any of the fires, though none were found. On the first of May seven barns in Hackensack, New Jersey, were on fire all at once, obviously set, and two suspected Negroes were burnt at the stake. This news fanned the fear and anxiety in New York to such a pitch that hundreds of families actually packed their belongings and fled to the temporary safety of the hills and fields beyond Canal Street.

On May 11 Caesar and Prince were hanged for having stolen the linen, though it was also assumed they were guilty of being leaders in the "Negro Plot" to burn New York. Caesar's sentence also decreed that, after being executed, he was to hang in chains on the island near the powderhouse. John Hughson, his wife Sarah, their daughter Sarah, and Peggy Kerry, were also sentenced to be executed for receiving stolen goods, though the severity of the sentence was mostly due to their suspected leading of the whole "conspiracy." Though both John Hughson and his wife



From *As You Pass By*, Kenneth Holcomb Dunshee, 1952 (out of print).

admitted the capital offence of having received stolen goods, they stoutly denied to the very end that there was any plot to their knowledge to burn the city or any part of it. Peggy Kerry, faced with death by hanging, gave considerable testimony in support of the case against the Negroes and Hughson, hoping for some clemency. But the sentence stood pat and on her last day, filled with remorse for the tales she had told, Peggy bitterly denied everything she had said. As for Sarah, the daughter, that "wretch, stupefied and hardened in wickedness," the court agreed to "respite her execution in hopes that after her father and mother had suffered she might be molified to a confession of her own guilt." On June 12, John Hughson, his wife, and Peggy Kerry went to the gallows, and John's body was hung in chains beside that of Caesar's.

The many Negroes named by Mary, Sarah, and Peggy were rapidly dealt with. Hardly a day passed without an execution. Those who failed to admit their guilt, or to give incriminating information about others, were considered vile and stubborn and burned at the stake. But to those who confessed and informed, the court showed mercy, and hanged them instead. Lucky indeed were those who were merely banished from the country.

In the meantime there continued to be outbreaks of fire; most were of a trifling sort, but some were certainly set and all were believed part of the "villainous design." Court adjourned at the sound of each alarm, for many of the jurors and witnesses were members of the fire department. The town treasurer paid one fireman "Johannes Roome...the Sum of Forty Eight pounds: fifteen Shillings and Ten Pence...for making gallows: two Gibbetts...Ladders and fire hooks etc."

Toward the end of June a man named John Ury was arrested on suspicion of being a Roman Catholic priest, and of practicing "Popery" within the city (a capital offence in New York at that time). They stood him before Mary Burton and she promptly accused him of playing a prominent part in the conspiracy. Why it hadn't occurred to her to mention his name before, she did not say; nor was she asked. After the usual brief, one-sided trial, he was found guilty, sentenced, and hanged, denying to the last any part in such a plot.

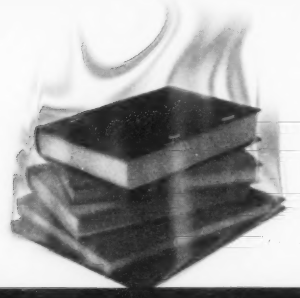
John Ury neither admitted nor denied that he was a Roman Catholic priest, but he never concealed the fact that he was a deeply religious man, and the speech he made from the gallows was one of true Christian understanding, humility, and forgiveness that must have rung and rankled in many guilty ears for some time after. With great composure he said, in part:

> I am to appear before an awful and tremendous God...in the presence of this God, I lift up my hands and solemnly protest I am innocent of what is laid to my charge...never had I any knowledge or confederacy with white or black as to any plot.
>
> In fine, I depart this waste, this howling wilderness, with a mind serene, free from all malice, with a forgiving spirit... praying that Jesus, who alone is the giver of repentance, will convince, conquer and enlighten my murderers' souls....
>
> And now, a word of advice to you, spectators: behold me launching into eternity: seriously, solemnly view me, and ask yourselves severally, how stands the case with me? die I must? am I prepared to meet my Lord when the midnight cry is echoed forth?

Even after Ury's execution very few white people would dare deny that the "Negro Plot" was a very real threat, but they were beginning to feel uncertain about their behavior. When Mary finally accused some prominent New Yorkers, including one of the magistrates, her wicked mind was at last exposed, and the whole case collapsed in silent embarrassment. The ugly blot on American history stopped.

One hundred fifty-four Negroes were committed to jail, thirteen burned at the stake, eighteen hanged, and seventy transported. Twenty whites were jailed, four hanged, and eight transported. The bodies of Caesar and John Hughson were left hanging and rotting throughout the hot summer months. The following March, Mary Burton applied for, and received, the hundred pounds reward. ❀

Left: In the late eighteenth century, "Molly," a slave of one of the Knickerbockers of New York, achieved local fame as a volunteer for the city fire department. Commemorated by the white firefighters, she once heroically helped pull Company 11's engine through a blinding snowstorm. At a time when (white, male) fire departments were THE organization of political power and heroic romance, Molly earned the moniker "Volunteer No. 11."



Burning Libraries

by Stewart Brand

Adapted with permission from *The Clock of the Long Now*, by Stewart Brand (see review, page 95).

In Tom Stoppard's contemporary play, *Arcadia*, the budding genius Thomasina laments to her tutor about the burning of the ancient Library of Alexandria, "Oh, Septimus!—can you bear it? All the lost plays of the Athenians! Two hundred at least by Aeschylus, Sophocles, Euripides—thousands of poems—Aristotle's own library!...How can we sleep for grief?"

So who burned the Library of Alexandria? War did three times, inadvertently. Religious bigotry did twice, on purpose. We are right to grieve. Only one in ten of the major Greek classics survived. Nothing like Alexandria's library was seen again for a thousand years.

A different reason for burning books was originally invented by China's first great emperor, Shih Huang-ti, in the third century B.C.E.

In 213 B.C.E at an imperial banquet, a Confucian scholar offered criticism of such a severe break with the past. "Nothing can endure for long," he said, "but that which is modeled on antiquity." The emperor's grand councilor Li Ssu responded, "There are some men of letters who do not model themselves on the present, but study the past in order to criticize the present age. They confuse and excite the ordinary people. If such conditions are not prohibited, the imperial power will decline above and partisanship will form below." The order went out to burn *all* books in the empire except only those dealing with agriculture, medicine, and fortune telling. To even discuss the forbidden works was punishable by death. The pathetically few early classics to survive the conflagration had to be later rewritten from memory.

The same impulse inspired Hitler's book-burning ceremonies of May 1933. "The German form of life is definitely determined for the next thousand years," he declared. The new propaganda minister, Joseph Goebbels, told the students at the bonfires, "These flames not only illuminate the final end of an old era, they also light up the new."

The danger continues. Cultural arson was unleashed again in August 1992, in Bosnia. For three days Serb forces targeted Sarajevo's multicultural National and University Library with a bombardment of incendiary grenades. Bosnia's written heritage was consumed—a million and a half volumes, one hundred fifty-five thousand of them rare books and manuscripts. The library's director said that the Bosnian Serbs "knew that if they wanted to destroy this multiethnic society, they would have to destroy the library." In horror at the event, librarians worldwide have established an Internet-based Bosnian Manuscript Ingathering Project [www.applicom.com/manu/ingather.htm] to track down duplicates and replace as many as possible of the lost documents.

Starting anew with a clean slate has been one of the most harmful ideas in history. It treats previous knowledge as an impediment and imagines that only present knowledge deployed in theoretical purity can make real the wondrous new vision. Thus the French Revolution of 1789, the Russian Revolution of 1917, and the Chinese Communist Revolution of 1949 each made brave new worlds that catastrophically failed. By cutting off continuity with the slower parts of their cultures they had no fallback. The American Revolution of 1776, by contrast, was highly conservative. Its instigators studied Roman, Venetian, and even Iroquois history for precedents. There was little of the brutal rhetoric of making a total break with the past. As a result, all the leaders who started the revolution lived to see it through to completion, and its innovations in governance aged relatively well. The Americans severed the political bonds with the Old World but not the cultural bonds. They burned their bridges, not their libraries.

Burning libraries is a profound form of murder, or if self-inflicted, suicide. It does to cultural continuity—and hence safety—what destroying species and habitats does to nature's continuity, and hence safety. Burning the Amazon rain forest burns the world's richest library of species. *The accumulated past is life's best resource for innovation.* Revolutions cut off the past. Evolution shamelessly, lazily repurposes the past. Reinventing beats inventing nearly every time. ❀

Bright and Warming Flames

Letters to the Burned Churches

REPRINTED WITH PERMISSION FROM *AN AMERICAN TESTAMENT: LETTERS TO THE BURNED CHURCHES* ©1996 ANTI-DEFAMATION LEAGUE.

During the mid-nineties' rash of church burnings across the South, the Anti-Defamation League and the National Urban League placed ads in several national newspapers, appealing not only for funds to rebuild the churches but for moral support for the bereaved congregations. The overwhelming emotional response has been distilled into a booklet (see access). Here, as written, are a few of those letters. —NP

Dear Church burning victims,

My heart goes out to you. It must be very scary and angering to see such a center of your community destroyed.

Be strong and keep hope alive. Hateful arsonists can not triumph over love and community.

I hope that my modest contribution will help to rebuild your sanctuary.

Dear Church member,

I don't know why a person would burn a church. I think that we worked hard to get our rights. By some person burning the churches hurts a lot. If someone doesn't like us they should come out and say so. They don't have to hide and burn down churches. Now when it's Sunday people can't go to the churches. So I'm very sorry about the burning of the church.

Dear Church Members,

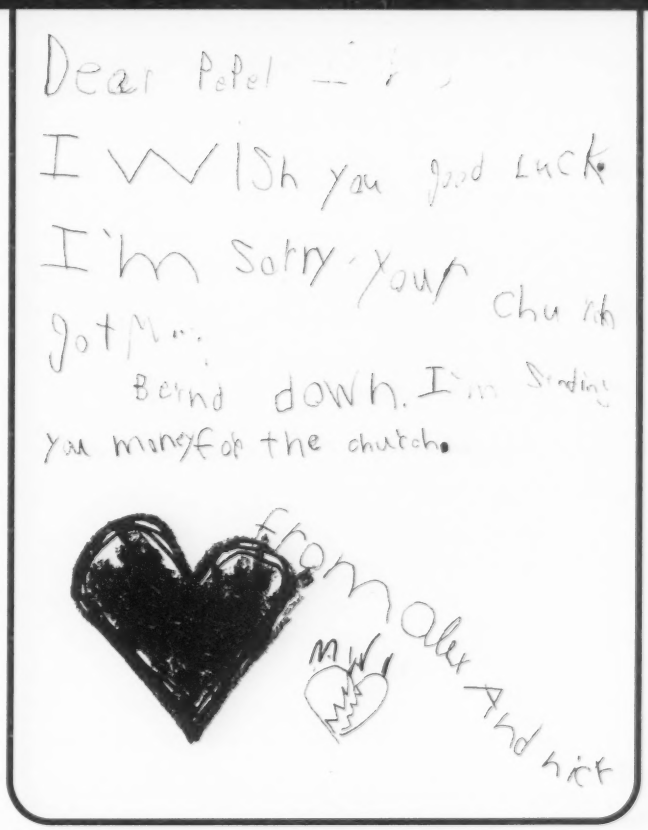
We offer you our sympathy and encouragement.

Our own families came here from England and Scotland seeking religious liberty many years ago. They were Baptists and Quakers and Presbyterians, Anglicans and Catholics.

So it's appropriate that we send this contribution toward the rebuilding of your church through the Anti-Defamation League. We are all outsiders and minorities together.

Dear Church Members,

Enclosed is a check for $18.00 as our contribution to help you rebuild your physical structure and your faith in people. →



Left: Asbestos suits for entering fires to save lives. KKK suits for burning crosses.

Each letter of the Hebrew alphabet has a numerical value. An aleph or A is one, a bet or B is two, and so forth. The numerical value for the word which means life in Hebrew (Chai) has the numerical value of 18. Many Jewish people choose this number for gifts to convey wishes for long life, healthy and prosperous years. So we wish your congregations years of good health, prosperity, and peace.

Dear Brothers and Sisters in Christ,

We are saddened (and outraged!) by the news that your church has been burned, and that there are still some people who seek to divide us by the color of our skin. If there is any consolation it should be this—that the result of these acts of hatred is to make people like me and my husband all the more committed to the fight against racism.

...Our son Alex is sending $2.40—almost two weeks allowance, in the hope that you will not lose sight of the fact that most of us decry these evil acts, and all bigotry, and pray for a world where we can live together in love, caring and acceptance.

"As A Fire is Meant for Burning"
(A Church Hymnal) by Ruth Duck

As a fire is meant for burning with a bright and warming flame,
So the church is meant for mission, giving glory to God's name.
Not to preach our creeds or customs, but to build a bridge of care,
We join hands across the nations, finding neighbors everywhere.

Book Burning Access

Bonfire of Liberties: Censorship of the Humanities
www.humanities-interactive.org/bonfireindex.html.

An online chronicle of book burning and other censorship through the ages.

Censorship and Book Burning Aphorisms
www.rjgeib.com/thoughts/burning/burning.html.

What Desmoulines said to Robespierre, and other choice little speeches on book burning.

Frequently Challenged Books: Rethinking Schools Online
Volume 12, No. 3. Spring 1998. www.rethinkingschools.org/Archives/12_03/cenfreq.htm.

Books that enrage, and the objections to them. (A few examples: *Of Mice and Men*, *The Catcher in the Rye*, *I Know Why the Caged Bird Sings*, *The Color Purple*.) The National Council of Teachers of English helps teachers keep such books in the curriculum. (CD-ROM coming soon: contact the NCTE at 800/369-6283.)

Church Burning Access

Anti-Defamation League
823 United Nations Plaza, New York, NY 10017. 212/885-7700, www.adl.org.

The ADL is now the top organization monitoring intolerance in the US. Single copies of *An American Testament: Letters to the Burned Churches*, are available free while they last.

Church Burnings Response Team
Community Relations Service, US Department of Justice, 600 E Street, NW, Suite 2000, Washington, DC 20530. 202/305-2935, www.usdoj.gov/crs/crs_off.htm.

CRS formed this federal conciliation service to work within local communities to fight church burnings.

Black Church Fires Online Resource Guide
General Board of Global Ministries, church_relations@habitat.org, http://gbgm-umc.org/advance/Church-Burnings.

Huge Web resource on church burnings. Extensive links to tolerance-driven organizations.

Habitat for Humanity International
121 Habitat Street, Americus, GA 31709. 800/422-4828, Rebuilding_Churches@habitat.org, www.habitat.org/newsroom/ChurchBurnings.html.

Habitat, working with the National Council of Churches, coordinates volunteers to assist in the rebuilding of burned churches.

Study Circles Resource Center
PO Box 203, Pomfret, CT 06258. 860/928-2616, scrc@neca.com, www.studycircles.org.

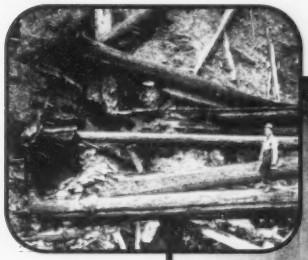
SCRC uses small-group, highly participatory discussions to address community problems. Single copies of the publication "*When a church is burned in our town...": A Guide for Community Dialogue and Problem Solving* are available free.

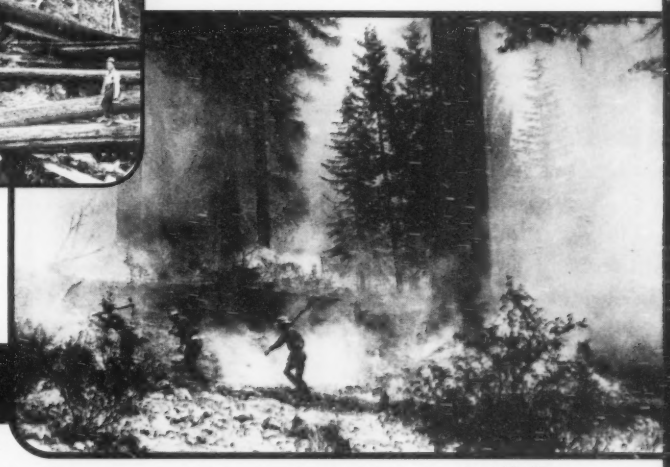
Klanwatch/Southern Poverty Law Center
Intelligence Project, 400 Washington Avenue, Montgomery, AL 36104. 334/264-0286, www.klanwatch.com.

Klanwatch now tracks more than 500 racist and neo-Nazi groups. Its quarterly *Intelligence Report*, free to schools and other qualified organizations, provides updates. Send requests for subscriptions on your letterhead to "Intelligence Report," at SPLC.

Wildlands: The Firefight

by Stephen J. Pyne





Inset: The War Eagle Mine, where Edward Pulaski and his crew weathered the fire at Placer Creek in 1910. Both photos from *America's Fires* (see page 64).

The colonization of America had sparked vast conflagrations before, but they ended, however brutally, with a pastoral of farms and fields. The fires of 1910, however, were not mediated by the calming hand of agriculture. The fires that flashed, simmered, and then boiled over throughout the American West that summer were different. Some fires kindled from lightning, some from traditional burning, some from railroad cinders and sparks, and not a few from arson. They burned through the bristling conifers of the Rockies, a rich compost of natural fuels, disturbed not by farms but by the extinction of the traditional fuel-culling fires of the indigenous peoples, and by the land-shattering wedges driven by mining and railroads.

This was, in brief, no simple tale of upset nature lashing out in retaliation, or of witless and venal humanity fouling its own nest. It was a tale of the two, mingled hopelessly and with volatility in ways that no one had yet seen. Here natural fire and industrial fire collided, largely on public lands, on lands specifically reserved from settlement, lands set aside to protect them from fire and ax. It was not clear, when the fires broke out, what this truly meant. No paradigm existed for what fire management protocols were suitable, what fire policy was most appropriate, what fire practices most usable.

The matter became more perplexing as the summer continued to dry and the fires smoldered and roared with the bellows of passing cold fronts. On August 20–21 the fires erupted. Of the 3.25 million acres estimated to have burned on the national forests of the Northern Rockies that year, perhaps 75 percent burned during a single thirty-six-hour period that became known as the Big Blowup. When it roared, hundreds of firefighters were strewn over the landscape.

Responsibility fell to the Forest Service. It was a young agency, staffed with young men, enflamed by a crusading zeal for conservation and traumatized by the dismissal of its charismatic chief, Gifford Pinchot. By August, the Service had hired some 9,000 firefighters, a staggering number, further reinforced by regular Army troops after August 8. Close to the epicenter around Wallace, Idaho on the day of the Big Blowup, some seven crews found themselves trapped on the rugged slopes, their eyes stung by cloying smoke, their ears ringing with a roar of winds like thunder, embers dropping like snowflakes. Some survived, some didn't. During that single afternoon, sixty-seven firefighters perished. Virtually every plot in American fire-fighting storytelling was told—invented—during those days and hours.

In one indelible incident, Ranger Edward Pulaski held his men in a mine adit along the West Fork of Placer Creek at gunpoint, while a firestorm raged outside. Of an original crew of forty-five, forty survived. Blinded and suffering lung ailments, Pulaski returned to find himself a reluctant hero. Later, he perfected a combination tool, an ax and hoe, that still bears his name. Forever after, every ranger, Hotshot, fireguard, Smokejumper, or casual laborer plucked out of a bar, anyone sent to a fire line, would grasp a Pulaski tool and in so doing retell the epic of 1910.

Light Burns to Prevent Big Burns

Even as the fires lit the Rockies like a slow supernova, that summer of 1910, voices rose to protest public land forest management—most

loudly in California. If foresters had burned the woods lightly, as the Indians and frontiersmen had, there would not be the ground litter to sustain these large fires or the doghair-thick saplings to ladder flame from ground to crown. If the government had adopted these practices, the woods would be healthier, money would not be incinerated in worthless firefights, and lives would not be lost. Light burning proposed that the federal agencies do what the federal agencies agreed they ought to do in 1996, eighty-six years later.

From America's Fires (see page 65)

A staged exhibition of how fire control mechanized almost overnight following the Korean War.

Light burning was the fire road not taken. In 1910, prescriptive light burning was challenged, then fought, then condemned as heresy and superstition, and finally squelched. The Forest Service not only defeated light burning but doused its California torchbearers. Light burning lost because it never had the conceptual clarity of fire control and lacked the academic standing of forestry; because its advocates stood outside the corridors of government; because its practice conjured up images of "Paiute forestry" insulting to a modern scientific society, and did not match the relentless proselytization of its adversaries—even though most of the American public, if they had thought about fire policy at all, would have agreed that all-out fire control on the 1910 model was wasteful, expensive, ineffective, and foolish.

Controlling fire (only after it started) won. Why? It triumphed because, in the end, it believed in itself. It won because Coert duBois invented an engineering model—systematic fire protection—that had mathematical rigor, where light burning appealed to empirical intuition. It won because the 1910 fires had brought horror as well as adventure, because those young men who stood against the conflagration refused to accept their sweat, our money, and the dead as lost. It won because the 1910 fires got institutionalized. Chief forester William Greeley, and Greeley's successor through the New Deal, Ferdinand Silcox, had both personally weathered the 1910 flames, the pivotal moment in their lives and the life of American forestry. Not least, the conflagration in the Rockies confirmed the use of emergency (off-budget) funds to fight fires, which gave actual suppression a fiscal carte blanche.

That same August of the Big Blowup—the blowup fires, the blowup politics—the great philosopher of pragmatism, William James, published his final essay. A pacifist, James was alarmed at what he saw as a growing militarism, an enthusiasm for martial virtues which would end a few years later in the trenches of the Great War. Why, he argued, was it not possible to find a "moral equivalent of war" in the same way that there existed a mechanical equivalent of heat? Why could martial energies not be redirected to useful purposes? Why, he reasoned, could there not be a national conscription of youths to begin a "war on the forces of nature"? Why not, indeed, for even as his essay found its way into print, Pulaski and crews were staggering out of their gutted hillsides.

Here was the institutionalization of an interpretation: the 1910 fires as battlefield, the firefight as moral equivalent of war. Over and again, those who have studied the fires or fought them in fresh avatars have reached for the military metaphor. What began as an idea became an instinct. Probably, today, it is inexpugnable. The flag flying at half-mast over the South Canyon fire in Colorado—a blowup that claimed the lives of fourteen firefighters in 1994—was retelling a story forged among the caves, rockpiles, and smoky white-pine forests of northern Idaho.

The warrior-hero fighting the demonic fire dragon is a fabulous story. America is lucky to have it. But the retellings have left us with a final form that sheds the complexity that our relationship to fire deserves, and that we need. Lost is the fact that Pulaski himself was more interested in tending the graves of those who died than in self-promotion; that the Carnegie Foundation refused him a hero medal because the firefight was part of his job and because Big Ed and his crew were in full flight, their tools tossed to any side of the trail, before they piled into the adit. Pulaski's story is of a man who, in a moment of crisis, had reached beyond himself. More broadly, it is the story of an institution—the Forest Service—that likewise reached beyond its bureaucratic origins.

But it is not the only tale to tell. The American tragedy is that, like light burning, all other stories ceased. If prescriptive controlled burning—widely recognized as useful and often necessary—is to succeed, if fire use is to complement fire control as paired cultural practices, it needs a story to tell that is at least as compelling as the one bequeathed by 1910. ❀

Restorative Fire Is Local Fire

Robert B. Hansen on restoring fire's creativity in the San Joaquin grasslands

Fire plays a regenerative role in your watershed. It is a specific and unique role, shaped by the winds and rains, the shape of the hills, the adaptations of the plants and animals. In most US watersheds, fire has been suppressed or applied in the wrong season or with the wrong intensity and frequency. Loving open fire means overcoming what we have been taught is a "natural" fear of flames, and learning what the watershed "desires," to be productive and diverse.

In the 1980s, Rob Hansen worked at The Nature Conservancy's 3,300-acre Creighton Ranch Reserve in the Tule River watershed, which feeds into the San Joaquin Valley (300 to 400 feet above sea level) in California. Creighton Ranch is the remnant of a valley—once filled with lakes, wetlands, and savanna—that has been 96-percent destroyed. Rob also worked at a smaller, drier site on the San Joaquin Valley's desert/grassland edge, called the Pixley Rural Pools Reserve.

While we could have consulted dozens of fire managers, Rob arrived with great bioregional credentials as teacher, consultant, and steward. He speaks with the new intimacy demanded by local fire work. He is modest. He cannot "restore" in the sense of bringing back every animal and plant. He can "rehabilitate," encouraging native wildflowers and pollinators and complexity by burning back the Euro-Mediterranean exotics that invaded with sheep and cattle. The modesty of the new restorers is both painful (Creighton Ranch is too small for pronghorn to return) and honorable (the fire-based restoration requires eternal stewardship). Rob's realism and joy point to a future local love for fire at home. —PW

In this part of the Valley, in this bioregion, fires burn in the fall after good years of rain have watered lots of grass and the grass has dried out. When a fire's underway and the smoke plumes ascend, certain birds key in. Swallows from far and wide converge and catch insects—grasshoppers primarily—as they flee the flame front. The swallows have a heyday.

Above: A prescribed fall burn in an annual grassland. Photo courtesy Rob Hansen.

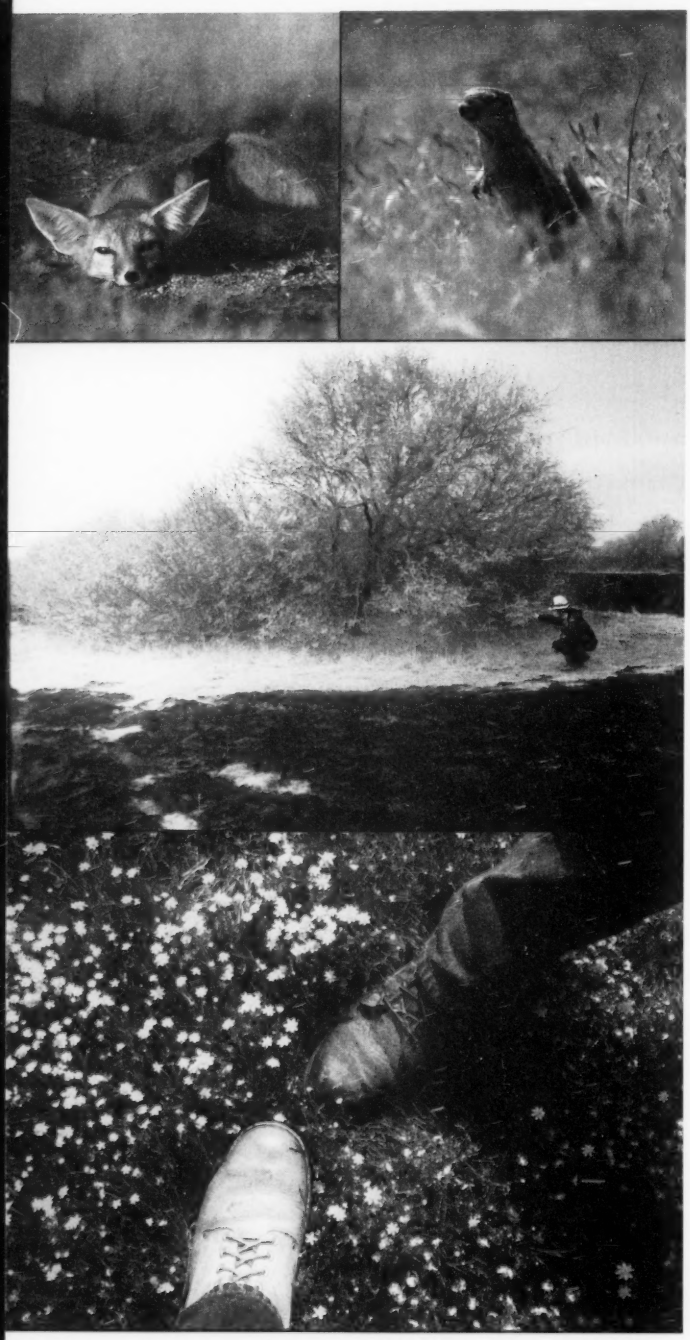
During the fire and immediately afterwards, Swainson's hawks search where the ground is black. A squirrel that blends into the dry gold grasses stands out pretty well against burned and blackened earth. The hawks also scavenge the big insects, grasshoppers and crickets, that may have had their wings singed.

Later in the fall and in winter, mountain plovers arrive and forage where fires have occurred. They like to either see the ground or forage on the ground in very short grass. (They avoid fields where European—invasive—annuals have flourished for a year or two and are covered with dried-up brome and *Hordeum*, or barley.) Mountain plovers can be difficult to find in the Valley; a good place to go looking is a burned grassland.

We occasionally see burned side-blotch lizards, the commonest lizard here. If they are not able to get down into a ground-squirrel burrow, they can certainly perish. But most survive, and afterwards, when the ground is black, you can see them too, like the hawks, foraging for insects.

When fire is frequent enough—every two or three years in our grasslands—the fuel load never gets so large that the heat gets down into the burrows. The flame front passes any point in a field so

The restoration ecology movement is blossoming; can we bring fire back as a necessary friend in landscape healing?



quickly that it's probably not cooking anything down in a squirrel burrow. I suspect squirrels, toads, darkling beetles, garter snakes, whatever else is down in there, are doing pretty well.

Life goes on immediately after a fire. Within just minutes or hours, lots of animals are out foraging and carrying out their regular activities. Harvester ants, for instance, are back again, just pulling out seeds and gathering and packing them around their little ant colony entrance.

Restoring

In the 1800s, there were certainly both natural wildfires and human-set burns; both probably took place in fall. At the time Western settlers got here, the Yokuts were doing most of the burning or had a hand in it. So when we set fires now, we're not looking at fire as a means to restore the natural fire regime to some pre-human period. We're bringing back fire primarily to encourage native species, to give them some edge against the European exotics that arrived with cattle and sheep, and that otherwise leave the natives so little space.

If you read Holland's plant community descriptions, it has accounts of vast wildflower fields. There are just so few places today where you can see vast wildflower fields on the floor of the San Joaquin Valley. The one time when we can see something that looks a bit like these early descriptions is in the spring following a fall burn. It's pretty impressive.

So we work with fire, our past history, and the landscape as it exists, trying to give native species, especially forbs and wildflowers, a better chance to flourish.

Why We Burn

When the "thatch" of one to three years of annual grasses builds up, it creates a dry mass or mat of dead grass on the ground. The thatch does two things: it intercepts sunlight, and it catches a lot of the early-morning moisture that might otherwise fall on these grassland soils. The moisture's an important water source; we only get six to ten inches of rain a year. Burning the thatch bares the soil surface and exposes seeds to a lot more sun, a lot more of the first rains.

The native annual wildflowers appear to be adapted to periodic fire; they respond positively to

Opposite page, clockwise from top left:

The delicate and endangered San Joaquin kit fox once had the run of the native alkali marshes and saltbush scrub of the Valley floor. It's now found in grasslands and other sparsely vegetated habitats that allow easy mobility and good visibility. Photo from *Life on the Edge* (BioSystems Books, 1994).

Named for the white patch on the underside of its tail—and for its speed under retreat—the San Joaquin antelope squirrel typically colonizes open grassy areas in scattered saltbush scrub. It needs good digging ground: loams or sandy soils. Photo from *Life on the Edge*.

In a protective oasis created by a mow-line, a mesquite tree is checked for damage after a prescribed burn on Creighton Ranch Reserve. The mesquite was in good health, a testament to the precision with which such burns can be managed. Photo courtesy Rob Hansen.

Their boots dusted with pollen, conservationists inspect a field bursting with native-species diversity in the spring after a fall burn. Photo courtesy Rob Hansen.

Right: A prescriptive-burn crew assesses moisture and other conditions before a burn. Photo courtesy Rob Hansen.

fire-burned openings. If there's a huge biomass of non-native grasses lying on top of their seeds, they don't compete very well. Fire gives the natives a competitive edge.

Fire is almost an analog of grazing, because grazing opens the thatch layer and makes it possible for annual forbs to compete against exotic grasses. If you look at a little game trail where squirrels or jackrabbits have run across the fields, they trample the thatch down and have, in a way, the same sort of impact as grazing or fire. They create an area where there's not much grass left. Sun and water get to that spot real quickly. So the following spring, those little squirrel trails often blossom with the best native flowers, which are not found in the neighboring thatch layer.

Because grasses are all wind-pollinated, there are no animal pollinators associated with Creighton's grasslands. But once we have fire, we have more Goldfields (*Lasthenia*), Gilias (*Gilia*), Pink Owl's Clover (*Orthocarpus*), and Larkspur (*Delphinium*), and we see a broader array of pollinating wasps and flies. A lot of the solitary bees—the native species, not the European honeybees—return to the fields.

Alkali sacaton (*Sporobolus sp.*) is the most important native perennial bunchgrass, especially at Pixley. *Sporobolus* needs to be carefully thought about, because after a long stretch of time with no burning, the thatch layer is dense and there's a lot of fuel to carry the fire. And the bunchgrass itself usually has a lot of old, dead leaves lodged in it. During the first burn, the whole plant can be completely consumed. But once an area burns, and if burning returns in intervals of two to three years, fire appears to do to the bunchgrass what periodic grazing does—it stimulates it. The sacaton puts on a lot of new growth the year after a burn.

Although both cows and fires reduce fuel loads, open up thatch, and convert grass back to nutrients, cow pies in this part of the Valley do not decompose very rapidly. A lot of nutrients get tied up in the manure and remain trapped for a long time. We see dried cow pies that literally sit there for ten years after the cattle have been taken off. A burn pretty quickly reconverts a lot of nitrogen and phosphates, including the nutrients in cow patties.

So fires bring about fairly dramatic and rapid change. Grazing may have less of an immediate impact and more of a maintenance effect. Grazing can be used once we get a grassland the way we would like it to be, through burning.

Burning in the I-Zone

In the interface zone, the I-zone, the inherent people-danger of a grassland fire is pretty small. I'm sure there's some chance that a risk-reduction insurance company guy would probably tell me to shut up, but if the burns are done well, you can just step over a flame front. The fuels here are not like in a forest.

In our part of the Valley the population density is low. When we do the burns there are literally no neighbors. The Valley—still largely agricultural, with neighbors involved in agriculture—knows about doing burns to get rid of stubble, and so on.

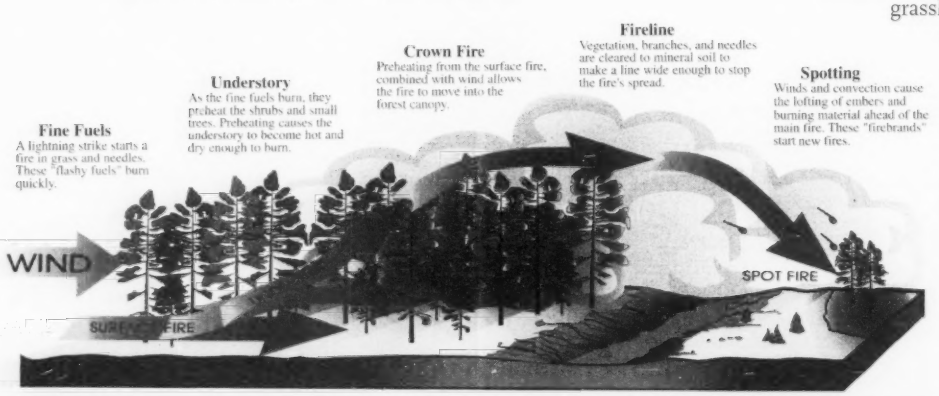
At other sites, with either dairies or residences within a quarter mile, we contact those folks ahead of time and do our best to keep them informed so that they're not having to react to the fire. We want them to know there will be a short smoky incident and that we'll do our best to minimize the smoke time, and certainly look after things like safety when the fire is anywhere near a well-traveled road.

We also check with the authorities. Ag-zone burns are done under agricultural burning permits, handled by either a county or air pollution control

district. At times, we'll have our crews and equipment ready, but either the humidity is too low and the fires would be too flashy, or the wind is too strong and we'd be dealing with a dicey situation to meet permit requirements. So we have to wait.

The county has the right to limit the number of burns or a certain acreage of burns anytime; so even for such innocuous fires as prescribed burns, on a "non-burn day" we're the ones who sort of pull that short straw.

On private wildlife preserves, like Creighton, we can use more than our professional Nature Conservancy staff. We make an announcement to our membership in our newsletter and to folks on our mailing list. They can come out and volunteer to help, either preparing black lines or handling suppression or follow-up. If the interested public (especially urbanites) has a chance to actually be part of these grassland fires and see the beneficial results, to understand that fire has been—and probably still can and should be—a natural part of grasslands, that it keeps the grasslands in grasses and wildflowers, that it keeps perennial woody vegetation from encroaching, I hope they'd come to understand fire as good news. ❀


Fine Fuels
A lightning strike starts a fire in grass and needles. These "flashy fuels" burn quickly.
Understory
As the fine fuels burn, they preheat the shrubs and small trees. Preheating causes the understory to become hot and dry enough to burn.
Crown Fire
Preheating from the surface fire, combined with wind allows the fire to move into the forest canopy.
Fireline
Vegetation, branches, and needles are cleared to mineral soil to make a line wide enough to stop the fire's spread.
Spotting
Winds and convection cause the lofting of embers and burning material ahead of the main fire. These "firebrands" start new fires.
WIND
SPOT FIRE

America's Fires: Management on Wildlands and Forests
Stephen J. Pyne. 1997. Forest History Society, 701 Vickers Ave., Durham, NC 27701. 919/682-9319.

Start here. The best short summary of US wildland fire history available: aboriginal, frontier, suppressed, and prescribed. —PW

The Ecology of Fire
Robert J. Whelan. 1995; 356 pp. $31.95. Cambridge University Press.

An academic book but the most inclusive of ecological thought and fire's impacts on natural communities. — PW

Fire Web Sites

Satellite Fire Atlas (NASA)
http://modarch.gsfc.nasa.gov/fire_atlas.

International Forest Fire News (UN)
www.ruf.uni-freiburg.de/fireglobe.

Published by the Global Fire Monitoring Center, a gold mine of links to global fire data and project descriptions.

National Interagency Fire Center (USA)
www.nifc.gov.

Current news, updates, agencies, links to fires.

U.S. Forest Service Fire Software
www.fire.org.

Download software and play with virtual fire.

International Association of Wildland Fire (IAWF) Bookstore
www.wildfiremagazine.com/bookstor.shtml.

800 books and videos, for starters.

Daily Fire Situation Report (USA)
www.nifc.gov/news/sitrept.html.

Current news of ongoing fires and a year-to-date summary.

Satellite Survey Current Fire Events (NOAA)
www.osei.noaa.gov/Events/Fires/index.html.

UN Environment Program Fire Survey
www.grid.unep.ch/fires.

Global Fire(Animated Year)
http://modarch.gsfc.nasa.gov/fire_atlas/movies/FIRE_ANIMATION.GIF

U.S. Forest Service Fire Weather Data
www.fs.fed.us/fire/planning/nist.

Intermix Fire Web Page
www.firewise.org.

Video Access

Wildland Fire: How Can We Live With It?
DANR Communication Services, University of California. 1997; 14 minutes. $20. DANR Communication Service-Publications (Video No. V97-1), 6701 San Pablo Avenue, Oakland, CA 94608. 800/994-8849, 510/642-2431, danrcs@ucdavis.edu, http://danrcs@ucdavis.edu.

The heat is up over the issue of open and natural fire in wildlands affecting civilization-creeping summer homes and subdivisions. This slick video oh-so-carefully offers pros, cons, action, and opposition, with the ultimate refrain, "let's talk." —PW

U.S. Forest Service Video Library
No cost except return postage. Audience Planners, Inc. 5341 Derry Avenue, Suite Q, Agoura Hills, CA 91301. 800/683-8366, 818/865-1233, http://www.r5.fs.fed.us/video.

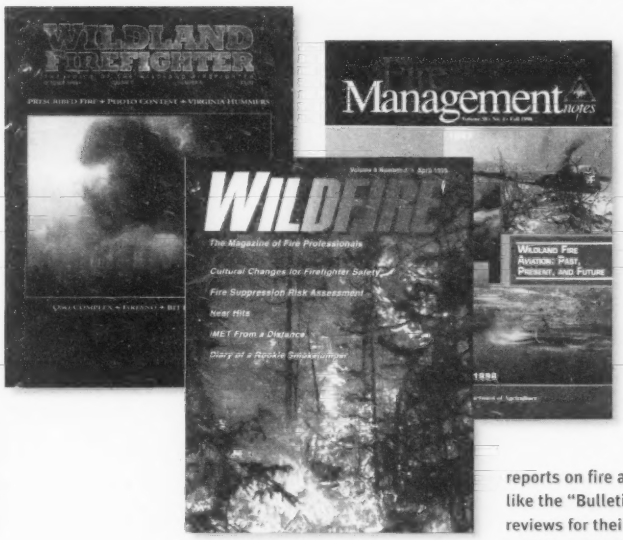
The Forest Service maintains a great library of videos (and films and slide shows converted to video) on subjects ranging from Forest Service careers, to the destruction of Native American archaeological sites on public lands, to fire-fighting technique and history. Some are available in close-captioned versions. See Video site (above).

Forest Smokechasers
1948; 27 minutes. Program No. V2811.

This historical training film follows a lookout. He backpacks to single-handedly extinguish a lightning fire (using only a shovel and a Pulaski). Absolutely matter-of-fact, without glamorization (or discussion of fire-management). You can't help admiring the fortitude of the solitary smokechaser. —MKS

Fifty Years with Smokey Bear
1993; 23 minutes. Program No. V2780.

Smokey may be the greatest success story in the history of advertising; he's second only to Santa Claus in name/face recognition. Meet the artist who put him in pants, and sing the Smokey song along with Roy Rogers. —MKS



WILDFIRE
The Magazine of Fire Professionals

Jason M. Greenlee, ed. $25/year (12 issues). International Association of Wildland Fire, E. 8109 Bratt Road, Fairfield, WA 99012. 509/523-4003, greenlee@cet.com, www.wildfiremagazine.com.

WILDLAND FIREFIGHTER
The Voice of the Wildland Firefighter

Brian Ballou, ed. $45/year (12 issues). North American Wildfire Ltd., 2532 Gray Oak Lane S., Salem, OR 97302. 800/964-8971, pulaski@teleport.com, www.wildlandfirefighter.com.

FIRE MANAGEMENT NOTES
Robert H. "Hutch" Brown, ed. $8.50/year (6 issues). US Department of Agriculture Forest Service, Superintendent of Documents, PO Box 371954, Pittsburgh, PA 15250. 202/512-1800, www.fs.fed.us/fire/planning/firenote.htm.

These publications represent the full extent of wildland fire magazines available in the US today. *WILDFIRE* was the first professional firefighter magazine. It's the monthly publication of the International Association of Wildland Fire, so articles and news briefs span the globe. Themes range from Hotshot Crews to fire aviation. Regular features include a new-equipment section and the "Near Hit" column, describing safety infractions on the fire line. A great calendar section includes meetings, symposiums, and workshops. *WILDFIRE* is well written, with great insights into the culture of wildland firefighters. It's full of colorful and descriptive advertisements for wildland firefighting resources. A bit technical, but there's something in here for everyone.

***Wildland Firefighter* is also aimed, specifically, at those of us who fight fire in the brush, woods, and prairies. Great articles on Smokejumpers and the wildland community. It does a good job of covering specific fires with in-depth articles about tactics and strategies, describing what worked and what didn't. "Regional Round-up" reports on fire activity around the country. I like the "Bulletin Board," new-equipment reviews for their straightforward approach, and the quality photos. (The monthly Photo Gallery features high-quality images, taken by wildland firefighters, that really give you a sense of what it's like on the fire line.) *Wildland Firefighter* and *WILDFIRE* share many of the same elements and are very comparable publications, but *Wildland Firefighter* is more specifically aimed at fire personnel and their interests.**

***Fire Management Notes* is put out by the US Forest Service. With a federal perspective, it provides a nice mix on fire science, including articles on fire suppression technologies and the ecological role of fire. As a government publication, this magazine lacks advertisements and extensive equipment reviews (this may be a plus for many readers). I particularly like the frequent contributions on prescribed fire and public education. It also does a great job in its coverage of the "fire use" versus "fire control" debate—a policy shift occurring within many agencies, but most acutely felt at the federal level.**
—Robin Wills

"South Canyon Fire, Colorado. 1994. A wall of flame rolled up the side of the mountain and over the heads of 60 wildland firefighters. Fourteen died. Sons, daughters, mothers, fathers, sisters, brothers, and our co-workers—their lives ended tragically, and much too soon.

...We've learned many things from South Canyon, and from other fatality fires as well. Sure we've changed procedures. We've added new rules, new training, and new methods for analyzing and correcting our mistakes. But...the changes we make to prevent future fatalities won't make the critical difference we need unless we begin to look at the behaviors that lead to the tragedies....our firefighting culture must change. We must embrace the strengths in our culture (and there are many), but be willing to give up the weaknesses in favor of improvement and change. In other words, we look forward to an evolution—not a revolution, in firefighter culture. —WILDFIRE

"Smokey's still a hero , but as the number and sizes of prescribed burns climb, the fire community has to reconcile Smokey's messages for the public. For aggressive RxFire programs to succeed, the public will have to learn about how fire can be both good and bad.

And sometimes it's not just the public who need a little spin on fire prevention—sometimes it's fire agencies themselves. Those who work in prevention, public affairs, or air quality—if they aren't up to speed on prescribed fire—can douse a planned burn even faster than an outraged smoked-out public can. —WILDLAND FIREFIGHTER

"*Fire websites for kids young and old*:

Project Learning Tree: www.plt.org/.

...ready-made lessons for classrooms, nature centers, museums, and scouts.

How a Fire is Fought: www.iias.com/forest/fightfire.html.

Very nicely done with simple but accurate language and great photos.

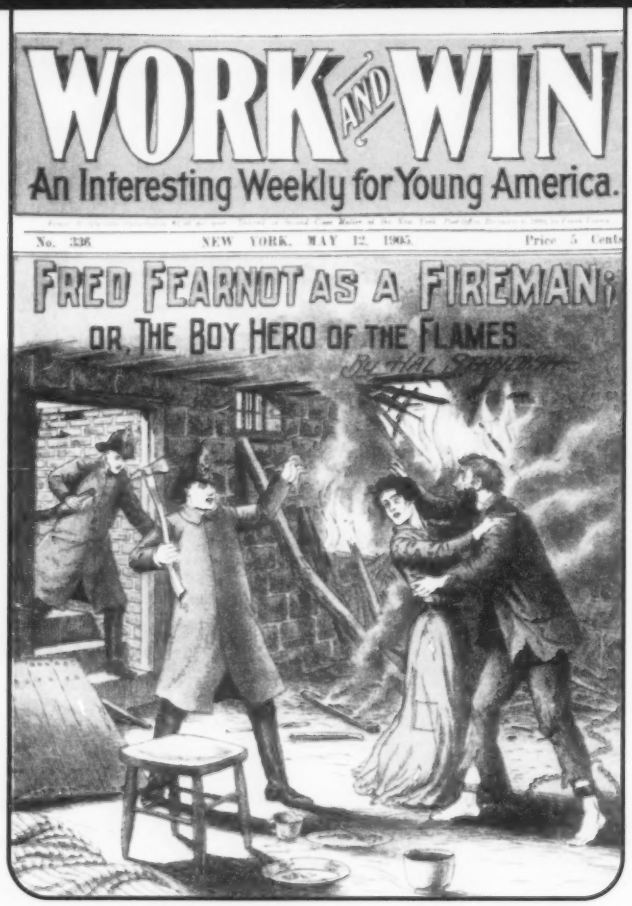
Woods on Fire: http://whyfiles.news.wisc.edu/018forest_fire/.

Fire history, cycles, ecosystem connections, Rx fires that get away. —WILDLAND FIREFIGHTER

"We fail to weigh the risk and cost of using aircraft resources against the probability of success when we use helicopters to mop up fires where fire behavior indicates little threat; when we use air tankers to drop retardant at midslope where fire behavior shows that the fire will burn to the top of the ridge no matter what we do; or when we use retardant aircraft without the benefit of having firefighters on the ground. Such risky, ineffective practices amount to fighting fire based on convenience rather than fire behavior. —FIRE MANAGEMENT NOTES

Mixing Fires, Mixing

The Urban, Wild, Wurban, Wanburld Omelette


WORK AND WIN
An Interesting Weekly for Young America.
No. 336 NEW YORK, MAY 12, 1905 Price 5 Cents
FRED FEARNOT AS A FIREMAN;
OR, THE BOY HERO OF THE FLAMES

Above: The exploits of fireman Fred Fearnot were a fixture in the boys' magazine *Work and Win*, in the early twentieth century. From *Keepers of the Flame* (see page 40).

by Stephen J. Pyne

For American fire agencies, the dominant fire problem has become flame in the "wildland/urban interface." More simply, one could call it the "intermix" fire, since the scene mingles wild and urban fragments into an ecological omelette. This new fire frontier—common to all industrial societies that thrive in fire-prone landscapes—has jammed urban and wildland fire agencies together and forced them to negotiate tactics, tools, even terminology. A common narrative has proved more elusive.

In principle, people can control everything about urban fire. They can choose their building materials (fuels), they can arrange the buildings in blocks to frustrate fire spread, they can replace open flame with other ignition sources, they can quickly attack, confine, and extinguish any fiery breakout. When towns were made of wood and thatch—when they were reconstituted wildlands—they burned like wildland fires. But engineering, building codes, and the wholesale replacement of combustibles by pre-fired materials like brick have strangled flame from the urban landscape. Only a fraction of calls that nominal "firefighters" now roll out of the station to answer are, in fact, fires.

All this makes for an easily constructed moral universe because it means fire results from breakdowns in the social or ethical order. The context is one of people behaving foolishly, or maliciously, or selfishly. Fires track the fissures in the built landscape, breaking through where corrupt politics, fraudulent insurance firms, serial arson, or riots strew combustible litter and cast their torches.

Urban fire services are among the fiercest moralizers of the modern world. Against society's quagmire of compromisers and phonies stands the firefighter, skilled in his craft, relentless in his selfless quest to protect the innocent. Against the swirl and shoddiness of modern life, the fire service presents a vision of a world properly designed and of a people well behaved. Urban fire stories are thus profoundly social narratives. People interact with people; the firefighter is a rescuer, the rugged savior of a helpless victim. If the threatening flames shrivel away, something else can serve the same purpose; bombs, car wrecks, hazardous spills. In novels and personal narratives—Dennis Smith's *Report From Engine Co. 82* or Larry Brown's *On Fire*, for example—the conflict, the moral drama, is

Stories

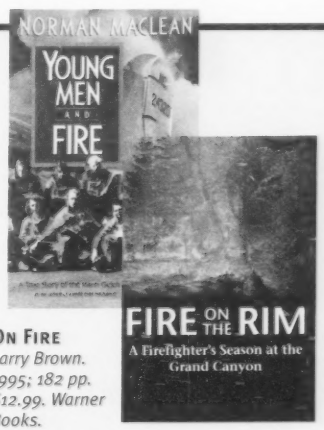
A US Forest Service Smokejumper, one element in a highly effective rapid-strike force against wildfires. Photo from *America's Fires* (see page 64).

an encounter between people, mediated by fire. The firefighters are themselves members of a tightly knit brotherhood, almost monkish, bound not only by training and uniforms but also by unions and an intricate internal hierarchy.

For wildland firefighters, fire season is a time in their lives, an autumn between adolescence and adulthood, when for a few summers they go into the woods, fight fire, and then leave. It is a rite of passage, not a vocation. Its base narrative is a coming-of-age story, which, for all the camaraderie, resides within the individual. Especially in the American West, fires ripple through places that are by edict uninhabited public space. The confrontation is between a person and nature; the prevailing group metaphor is the firefight, an army engaged in a moral equivalent of war. Too often the narrative degenerates into adventure accounts and juvenile sports stories. Fire serves to crank the plot, but because it typically comes from nature, the moral drama remains as thin as dry grass. A flood or storm could drive the narrative as readily. The ways a person confronts wildland fire are sparser than the infinite interactions an urban social drama can conjure up. Until Norman Maclean's *Young Men and Fire* (1992), a serious literature of wildland fire scarcely existed. Maclean solved that old quandary by making the firefight into an existentialist tale. His meditation captured the profound sense that fire is something transcendent, beyond the ultimate grasp of human control. He did it so thoroughly, however, that his book may have exhausted what is, after all, a lean genre.

But what wildland fire lacks in society, it gains in nature. Environmental ethics can fill the moral voids of a story set in largely uninhabited lands. What we do to nature (alter or preserve it) is no longer considered ethically neutral. What we do with fire has consequences that both reflect and project human values. Combustion is an ecological process for which there are few technological surrogates. Our fire practices affect biodiversity, carbon sequestration, nutrient cycling, greenhouse gases. Human suppression of fire is as ecologically powerful as arson. In that realization is the basis for a new genre of fire literature; it is not, however, a narrative likely to bond city with country. ❁

Firefight Greats



Young Men and Fire
A True Story of the Mann Gulch Fire
Norman Maclean. 1992; 301 pp. $19.95. University of Chicago Press.

Fire on the Rim
A Firefighter's Season at the Grand Canyon
Stephen J. Pyne. 1995 (revised preface); 323 pp. $14.95. University of Washington Press.

Report from Engine Co. 82
Dennis Smith. 1999; 215 pp. $14. Little, Brown & Company.

On Fire
Larry Brown. 1995; 182 pp. $12.99. Warner Books.

Glitter & Ash
Dennis Smith. (Out of print.)

Nude Ranching

by J.D. Smith

This story came from a pile of hay bales next to the lodgepole corrals near Moss Springs at the trailhead into the Eagle Cap Wilderness of Eastern Oregon. Dewie Lovelace and I were watching as a squirrel dismantled a pinecone. Something about the process reminded him of Tom Darby....

"During that last depression there was an old bachelor named Tom Darby ranching up here on the Big Minam. It is awful steep country, long ways away from town. Tom was an only child, and never met any kind of woman who wanted to live that far away from absolutely everything.

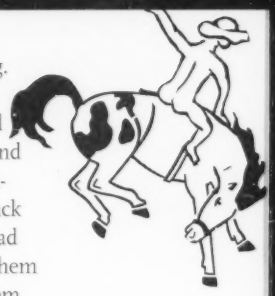
"Now, you hear a lot about the Great Depression, about Wall Street this, and Wall Street that. Fact of the matter is, depression is a human condition. You take enough away from folks and they get depressed, especially when they figure out that the money they don't have anymore went into somebody's pockets. Hell, for every businessman jumping out of a New York window during that stock market crash there were three more out buying brand new touring cars.

"Tom Darby was not a happy man to begin with, but he did have two passions that kept his mind off things. One of them was little rat terrier dogs, had eight in a row that I know of, every one of them named Sandy, and the other was a love of anything that had anything to do with South America.

"I went to school with Tom. He was a one-subject human. South America was all he ever read about, or drew pictures of, or talked about. And he kept at it his entire life. After his folks died, he renamed his ranch the "Bolo" after those three-string balls that they toss at cattle in Argentina. Changed his Ricking D brand to a big old three-way burn with circles at the ends, awful stinky at branding time.

"Well, in about '38, when the bottom was clear out of the cattle market, an agent of the Union Pacific Railroad showed up on the Bolo and offered big money for ten sections of forested land, if Tom would carry the paper. Two thousand dollars down. Sounded too good to be true. He went for the deal, sold off the last of his livestock, gave the place over to the railroad, then took Sandy and moved plumb to Brazil. Figured to live out the rest of their lives half a world away from the snow on the monthly payments from the railroad.

"Well, they were down there a little over a year, hanging around the beach with all those tan women, just long enough to blow the two thousand. About then Tom got notice that the railroad had defaulted on the payments, that he owned the Bolo once again. So, he packed up Sandy and came home, to find that they now owned ten square miles of stumps. The railroad had logged off the entire place, then let ownership of their clear-cuts go back to Tom Darby.



"The house and the corrals were still standing. Having to do something to get by, he borrowed a couple of saddle horses off of my dad, and he and Sandy rode way down into the Owyhee country, and gathered up twenty-five good horses off of government land. They're called wild horses now, but back then most of the horses out there on the desert had been raised as farm animals. People just turned them out into the sage rather than let the banks sell them for dog meat. That's the reason you see so many big-footed horses in that herd today.

"Couple of months later, Tom went in the nude ranch business. Must of been all that tropical air he breathed made him think something like that would work on the Minam. He actually advertised in the La Grande and Baker City newspapers for people to come out to the Bolo, take off their clothes, and go horseback riding.

"It was an idea way before its time. Every rancher in that part of Oregon stopped by to pay a visit, but none of them were paying customers. Hell, there's married couples in that country that's never seen each other naked in the daylight. Besides, up on that part of the Minam River there's just a couple of days a year that it's warm enough to dig postholes with your coat off.

"Deep down, though, Tom Darby was a practical fellow. That fall, seeing that his guest ranch business wasn't working, and facing a high mountain winter with no cattle and no money, he and Sandy rode a full day downwind into the forest, and they started a forest fire, I mean a great big forest fire, so big that they had to bring the United States Army into La Grande to fight it. The government commandeered all the hotel rooms in three counties to lodge the officers. Bars and the whorehouses did real well too. Fire is sometimes awful good for business.

"I know Tom made five thousand dollars off that particular fire. Saw the check. He used his string of nude ranch horses to pack fire equipment into the woods, and the fire burned so long he probably would've made another five, but Sandy came up lame from following him in and out of the woods so many times. That dog was his only friend and Tom just couldn't stand to watch him limp. So, Tom Darby he just upped and quit, sold the whole pack string back to the government. Soon as Sandy could walk good again, away they went, back to Brazil. Far as I know, both him and the dog are buried down there. The Bolo is part of the wilderness now." ❀

J.D. Smith has written for us since forever. We've lost track of all the jobs he's had—and don't really care, as long as he keeps sending his short, true, and tall tales. —PW

To Burn or Not To Burn

by Peter Warshall and Michael K. Stone

How to purify the community of defilement (specifically, trash)? If communities said "every man for himself," bonfires of disposable diapers, plastic bags, old clothes, oily rags, newspapers, and raked leaves would quickly flare up on street after street, and empty lots and parks would amass huge piles of cans and glass. So we purify the community by trucking the "evil"—our garbage—to landfills for unceremonious burial, or to crematoria called incinerators, or to the hinterlands (when there *are* hinterlands).

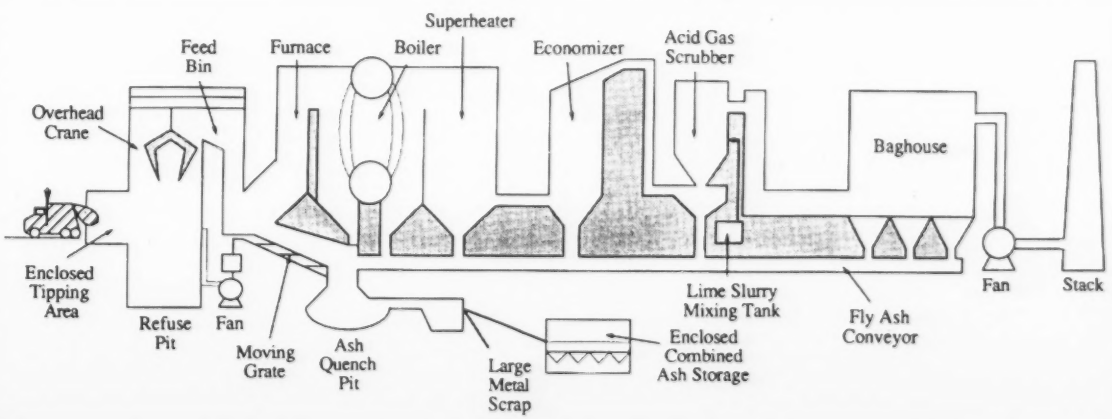
But the purification we seek has proven illusory. Landfills leak into our drinking water and their toxins return in fish. Incinerators belch hazardous gases and concentrate hazardous residues in their ash. The hinterlands protest against or charge heavily for burying foreign garbage. The story of "frustrated purity" solidified in the now-legendary barge plowing the Atlantic with Long Island's trash for two months, 6,000 miles, in 1987. Turned away at every port, it returned from exile, its cargo back in the Big Apple. The trash languished for four more months in Brooklyn before a final incineration and burial.

Since 70 to 90 percent of all city waste (65 to 75 percent by weight) is burnable, purification by fire has had its boosters, fans, and grubstakers. They point to dwindling landfill sites, NIMBY fights over new sites, and rising tipping fees as dumps become scarce commodities. They promote the latest in pyrolysis, the clean burn that destroys dioxins and furans, and point to new devices to limit harmful fly ash from spreading over the neighborhood. Garbage is no longer evil, they hard sell, but a newfound fuel, a resource for the creation of energy and electricity. You don't just incinerate, you generate. Extreme pyros claim that incineration is one hell of a lot easier—and cheaper—than sorting through the trash (recycling). It's a one-stop pickup and then out-of-sight, out-of-mind.

Pyro trash-handlers began to confront recyclers, worried citizens, and financial conservatives in the mid-1980s. Recyclers looked garbage in the eye and dreamed of a trash-free future. They're damned thoughtful and they've begun to replace fire rituals of leaf burning and incinerating in backyard metal drums with sorting rituals (glass, paper, aluminum, yard clippings, trash). But their trash-free community remains a dream. Even the best programs, such as Seattle's (see next page), have to date achieved only a 50-percent trash reduction. In the absence of government requirements, like Germany's, to reduce packaging and manufacture 100-percent recyclable consumer goods—anathema to most don't-tread-on-me Americans—it is hard to believe in an American willingness or capacity for a zero-waste lifestyle. Until then, the burn-it-or-bury-it rituals and politics thrive.

To recyclers, incinerators appear as hungry ghosts. To generate energy efficiently depends on a steady fuel stream. Will incinerators' constant, insatiable hunger dampen enthusiasm for recycling? Will the Big Burner stop progress toward manufacturing products made of totally recyclable materials, and make America even more apathetic toward laws to stop wasteful packaging? Does burning save enough landfill space to be worth the cost? You must still dump the ash and the nonburnables like construction demolition sheetrock.

A modern mass-burn MSW (municipal solid waste) incinerator. From *Recycling & Incineration* (see review, page 70).



Meanwhile, the fiscal conservatives wonder whether incinerator fires burn more money than they're worth. Who pays the very expensive initial price tag? Do citizens get to vote on the bond issues? If the incinerator can import trash/fuel, what's the equitable tipping fee? What if the communities can't provide the anticipated volume of trash/fuels, will they have to pay for the lost electricity production? And, if the regulations insist, will there be still be costs for the landfill, export of ash, and recycling?

To burn or not to burn plays on local stages (see access). Europe—with less landfill acreage—has been friendlier to Big Burners. European promoters willingly horse-trade job guarantees for permits to build. The US, with more acreage and poor communities willing to accept other communities' garbage, has less predictable preferences. Take Spokane and Seattle, two cities in Washington State:

• Seattle: After considering incineration, the city decided that high-level recycling plus lower-level landfilling is cheaper and less environmentally damaging. They achieved a 50-percent reduction, focused on commercial trash. They continue to encourage recycling, but have shifted the emphasis to waste reduction. Total waste generation (recycling plus disposal) continues to inch up, and the King County landfill is moving toward capacity; Seattle's non-recyclable waste is shipped by train to Oregon.

• Spokane: Over a fifteen-year period, and despite every style of citizen opposition, the city council has supported—and continues to have enough votes to sustain—closing local sanitary landfills, building an energy-recovery incinerator, and exporting excess trash and ash by train to a landfill 200 miles away. Recycling efforts in Spokane were not very effective in lowering garbage collection costs, or in eliminating the perceived need for the incinerator.

Fire has returned to the city consciousness, and confused urbanites have yet to choose which rituals (earth burial, combustion, mindful sorting) best purify the neighborhood. ❀

Access to Ashes

The Politics of Garbage
A Community Perspective on Solid Waste Policy Making

Larry S. Luton. 1996; 307 pp. $22.95. University of Pittsburgh Press.

Spokane's fight, with sobering lessons for activists.

The Waste and the Backyard
The Creation of Waste Facilities: Success Stories in Six European Countries

Bruno Dente, Paolo Fareri, and Josee Ligteringen, eds. 1998; 223 pp. $95. Kluwer Academic Publishers.

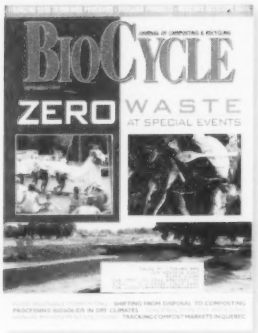
Heavy policy analysis of five European communities that accept incinerators. Very heady, very interesting.

Don't Burn It Here
Grassroots Challenges to Trash Incinerators

Edward J. Walsh, Rex Warland, and D. Clayton Smith. 1997; 292 pp. $17.95. The Pennsylvania State University Press.

All the variables, many surprising, that led eight eastern US communities to reject or accept incinerators. Sociology-speak. Great chapter on why incinerators have fallen from favor in the US.

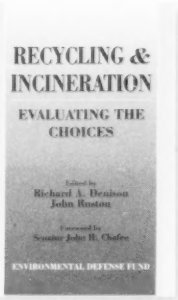
BioCycle
Journal of Composting & Recycling



Jerome Goldstein, ed. $69/year (12 issues). The JG Press, Inc., 419 State Avenue, Emmaus, PA 18049. 610/967-4135, biocycle@jgpress.com.

The recycler's answer to incineration. *BioCycle* is geared toward the compost industry, but is accessible and useful to anyone interested in reducing solid waste. New composting techniques/technologies; what's happening with composting and recycling worldwide; profiles of government agencies, prisons, schools, and other organizations; and business perspectives on making, selling, and utilizing compost in creative and profitable ways. And of course *BioCycle* addresses the fertilizer needs of farmers and others who work in the agricultural industry. —Liz Richardson

Recycling & Incineration
Evaluating the Choices



Richard A. Denison and John Ruston, eds. 1990. 320 pp. $24.95. Island Press.

On every level—individual, national, global—we have to deal with our discarded stuff. Trash isn't going to go away. *Recycling & Incineration* is the book that best describes how we choose to recycle, bury, burn, or otherwise dispose of our trash, and the long-term environmental, health, and legal costs and benefits.

Even though it's at times a bit academic, *Recycling & Incineration* is a community handbook, demonstrating how to realistically confront difficult and controversial topics (incinerator ash toxicity, emissions control, risk assessment, NIMBYism). The authors believe that by understanding the issues, we can make better choices and influence policy. The book's a resource of hope for all of us. —LR

❝ Though recycling may be less expensive than incineration, ample funding is still necessary to make large-scale recycling work. Currently, however, the fiscal policy of most states and cities proposing incinerators is to commit hundreds of millions of guaranteed dollars to incineration projects....

This imbalance must be rectified if recycling is to grow to its full potential. That is, recycling, landfilling, and incineration must be funded on a level playing field.

❝ The bottom line is that once it builds a WTE [waste-to-energy] facility, the community still will need approximately 40 percent of the landfill volume it would have needed without incineration....

Often, the claim is made that "incineration reduces the volume of waste by 75 percent" or some other high percentage. This claim can only be supported by making some misleading comparisons between the volume and weight of a typical ton of MSW [municipal solid waste] and volume and weight of a ton of incinerator ash. The claim cannot be supported when you consider the overall garbage disposal needs of the entire community.

Green Chemistry

First there were alchemists, then devil-may-care industrial chemists. Are green chemists, who will do no harm, about to be born?

by Bradley Pine

Excerpted with permission from "Students for Green Chemistry Help Build a New Benign Paradigm," in *in Chemistry* magazine, Vol. 8, No. 4. 1999.
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(see page 75).

Recently, at the corner of Connecticut Avenue and K Street in downtown Washington, D.C., where the policymakers, lobbyists, and high-priced public relations professionals converge, a quick survey found little, if any, knowledge of "green chemistry." Said one well-dressed lawyer, "I guess the easy, clever answer should be that it sounds like a new policy oxymoron, like 'politically correct' or 'military intelligence.'" A red-suited woman, exiting a cab and heading toward the government affairs offices of the new Daimler-Chrysler corporation, said it sounded "environmental, and if it is, I'm sure I'll hear more about it."

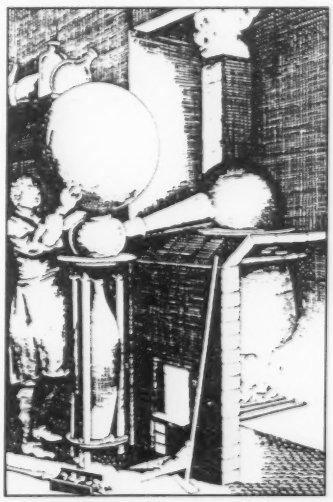
Linking environmentally benign assumptions with industrial chemical processes or public perceptions of chemicals in our lives has not always been successful. After all, the book that is widely credited with starting the modern environmental movement, *Silent Spring*, by Rachel Carson (1962), focuses almost entirely on the devastating effects of synthetic chemical pesticides. The resulting demonization of chemistry and the chemical industry has continued.

Part of the problem has been that the traditional criterion for evaluating a chemical process used in manufacture has been its yield. [The amount of product from] the chemical process or synthesis was the primary (and sometimes sole) focus of the chemist's effort. Questions about the environmental or health impact were traditionally left to others.

In the mid-1970s, the Monsanto Corporation undertook an advertising campaign, "Without Chemistry, Life Itself Would Be Impossible." Clever and easy to remember, it was intended to remind consumers that chemistry is part of almost everything we do every day. Chemists and science teachers around the country enjoyed hanging posters carrying this tag line and smiled at the tautology. This is self-evident, they thought, and if people took a moment to consider the notion, they would understand the importance and essentiality of chemistry and chemicals in everyday life.

The public was unconvinced. National surveys at the time linked chemistry with terms like "mad scientist," "nuclear winter," "pollution," and "inhuman." There was nothing "green" about it. This was, after all, the same period of our history in which Los Angeles experienced the worst air pollution ever recorded in the United States and the Cuyahoga River in Cleveland caught fire because of the thick layer of toxic and flammable chemicals. An entire city was closed because of toxic chemical contamination in Love Canal, N.Y., and the pristine Puget Sound was rendered unfishable at Commencement Bay in Tacoma, Wash., because the floor of the bay was coated with heavy metals and polychlorobiphenyls (PCBs)—residue of a decade of lumber processing. Chemicals, it seemed, were the root cause of our pollution problems.

Several years later, the paradigm was pushed further. The efficiency of natural versus synthetic products [was] challenged in groundbreaking research about the relative environmental impacts of paper and plastic (polystyrene) cups. Several studies, most notably the work of Martin Hocking of the University of British Columbia, dispelled the assumption that paper cups, because they were made of "natural products," were more environmentally friendly. In fact, the environmental costs of producing and recycling paper cups were similar to, if not more than, those related to the production,



The "new alchemy" links the design of chemical products with their impacts on human health and the planetary environment. Not since medieval times has the moral structure of society been so intensely involved with guiding the interests of chemistry to do no harm.

disposal, and recycling of polystyrene cups. This finding became important when fast-food giant McDonald's decided to develop a polystyrene recycling industry to reuse and recycle its hamburger containers. (McDonald's decision was later reversed under pressure from leading environmental groups.)

The paper cup controversy was one of many academic and public policy discussions that led to the acceptance of "externalities" as a measure of the real and total costs of environmental impacts. Externalities are the costs of product development that are outside of the direct line of production and not necessarily borne by the producer. These costs are often shouldered by society.

The Green Revolution

Green chemistry asks chemists to consider externalities. Rather than working only to maximize the yield of a particular synthetic process, chemists now must consider at what cost that yield will be achieved, and whether, within the context of the synthesis itself, a more effective process might be undertaken. [Costs are not just the expense of how-much-in, how-much-out, and making back your research investment as quickly as possible. They include the added expense of health and safety to workers and consumers, disposal of waste atoms and molecules, treatment of harmful by-products of chemicals manufacture, correcting harmful impacts in the environment (e.g., dioxins on fish), and using "too much" energy and "too many" sequences in changing one molecule into another. —*Ed.*]

DuPont chemists, for instance, developed a process that uses methyl isocyanate (MIC) as an intermediate for developing pesticides. Probably the most notorious chemical disaster in the 20th century involved the tragic death of thousands of people when MIC was accidently released at the Union Carbide facility in Bhopal, India. A safer production process that DuPont developed uses a catalytic approach that allows the generation of just the right amount of MIC [at just the right time] needed for conversion. As a result, MIC, which is very hazardous, does not need to be stored for the process, and potentially lethal spills or leaks are avoided. The process itself is safer and more atomically efficient, and the "*in situ*—just in time" approach reduced storage and liability costs for the manufacturer.

The benefits of green chemistry approaches are obvious....The final hurdle to fully accepting that green chemistry principles will be the guidelines, indeed the impetus, for scientists engaged in the discipline of chemistry is the education of the next generation of chemists. ❀

Twelve Principles of Green Chemistry

1. Prevention

It is better to prevent waste than to treat it or clean it up after it has been created.

2. Atom Economy

Synthetic chemistry should be designed to maximize the incorporation of all materials used in the process into the final product.

3. Less Hazardous Chemical Syntheses

Wherever practicable, synthetic chemistry should use and generate substances that possess little or no toxicity to human health and the environment.

4. Designing Safer Chemicals

Chemical products should be designed to effect their desired function while minimizing their toxicity.

5. Safer Solvents and Auxiliaries

Wherever possible, auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary and innocuous.

6. Design for Energy Efficiency

Energy requirements should be minimized. If possible, synthetic chemistry should be conducted at ambient temperature and pressure.

7. Use of Renewable Feedstocks

Whenever technically and economically practicable, raw materials or feedstocks should be renewable, rather than depleting.

8. Reduce Derivatives

Unnecessary derivatization (use of blocking groups, protection/deprotection, temporary modification of physical/chemical processes) should be minimized or avoided, because such steps require additional reagents and can generate waste.

9. Catalysis

Catalytic reagents (molecules that help construct others but do not change themselves) should be as selective as possible. They are superior to stoichiometric chemistry, in which each molecule of reagent that is used is consumed.

10. Design for Degradation

Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.

11. Real-time Analysis for Pollution Prevention

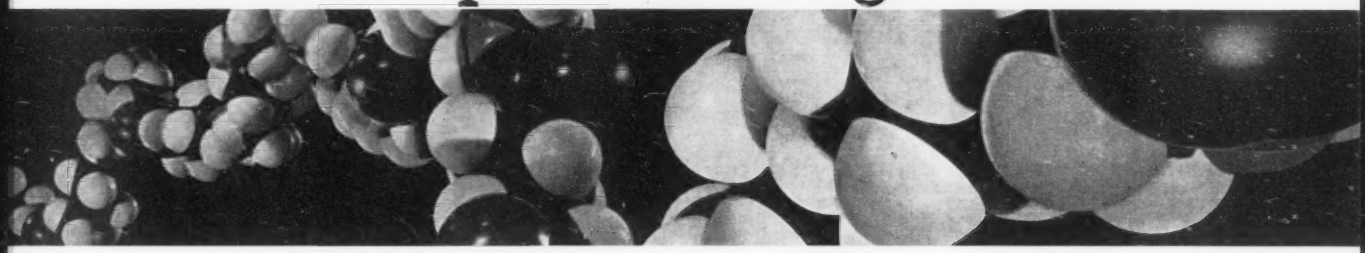
Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.

12. Inherently Safer Chemistry for Accident Prevention

Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.

Adapted from American Chemical Society Web site. Used with Permission.

EPA Presidential Green Chemistry Challenge Awards



Compiled and annotated by Michael Stone and Peter Warshall

Friendly vanillin. Catechol, an important chemical building block used to synthesize flavors (such as vanillin), pharmaceuticals (including L-DOPA and adrenaline), and agrochemicals, has traditionally come from petroleum-derived benzene. Karen Draths and John Frost of Michigan State University developed a process replacing gasoline-to-benzene-to-catechol with a new "green" process. The Draths-Frost synthesis uses a genetically engineered microbe to catalyze the conversion of glucose—derived from plants—into catechol. It's "green" because it substitutes renewable feedstock (plants) for non-renewable (petroleum). The Draths-Frost process also utilizes water (rather than a more environmentally damaging solvent), and takes place at temperatures that typically do not exceed body temperature: much less energy. It avoids all by-products from "cracking" petroleum in order to obtain benzene.

White paper from green chemistry. Union Camp Corporation developed C-Free™ technology, which substitutes ozone for chlorine as a feedstock for bleaching wood pulp. Ozone bleaching significantly reduces bleaching costs while decreasing effluents, including absorbable organic halides and chloroform, by up to 99 percent. Toxic dioxin and twenty-eight chlorophenols targeted by the EPA are nondetectable with ozone bleaching. (C-Free was nominated, but did not receive an award.)

Do-no-harm fire-fighting foam. In the 1960s, fires were doused with foams that released toxic hydrofluoric acid and fluorocarbon, poisoning firefighters. Bacteria were unable to metabolize the residual foam and many of its wastes. PYROCOOL Technologies, Inc. formulated PYROCOOL F.E.F. (Fire Extinguishing Foam) with highly biodegradable molecules. The new product needs only a 0.4 percent mix with water, compared with the 3 to 6 percent for conventional agents; required materials drop 87 to 93 percent. In one instance, PYROCOOL F.E.F. required just 12.5 minutes to extinguish a large oil-tanker fire of a sort that Lloyds of London estimated would require ten days to extinguish; as a result, 80 percent of the ship's cargo was saved and spillage of 78,000 tons of crude oil prevented.

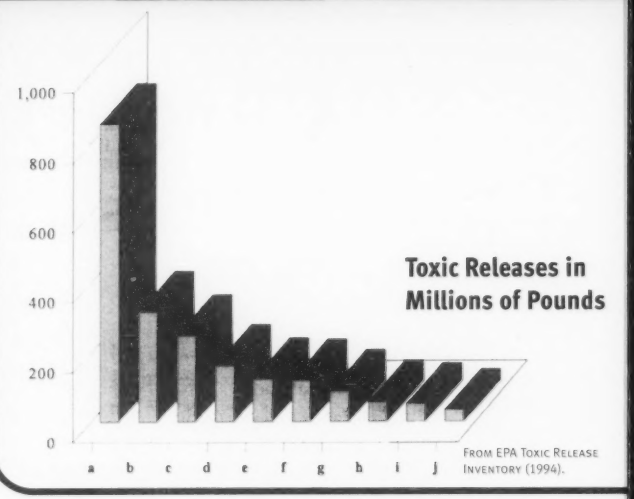
Green synthetic insecticides? Insecticides have been broad-spectrum, killing the good insects with the bad. Rohm and Haas Company's CONFIRM™ mimics a natural molecule within a caterpillar's body (20-hydroxy ecdysone) that "triggers" molting and regulates insect development. The caterpillar incorporates the applied synthetic mimic, which in turn disrupts the caterpillar's molting process, causing it to stop feeding and die. The insecticide is safer to use, because it has no biological function in most non-arthropods. It is safe for a wide range of beneficial insects—including predators on the caterpillars—and therefore should require fewer repeat applications, reducing the overall chemical load on the local environment.

Monsanto, green?! Monsanto considers its product Roundup (disodium iminodiacetate) to be an environmentally friendly, broad-spectrum herbicide. Originally, Roundup's manufacture required ammonia, formaldehyde, hydrochloric acid, and hydrogen cyanide. Hydrogen cyanide is acutely toxic. For every pound of Roundup, seven pounds of waste had to be treated. During synthesis, the reactions could get out of hand.

Monsanto designed a new chemical synthesis that is less toxic, can't run away with itself, has zero waste, avoids cyanide and formaldehyde, and has fewer steps. Its new catalysis can also be incorporated in the synthesis of other, greener chemical products. →

The lean, clean ibuprofen.

Muscle pain or headache. Can't take aspirin. Wonder where your ibuprofen comes from? It used to come from a six-step reaction in which only 40 percent of the atoms involved actually got used. Now, BHC Company has streamlined the manufacture of this steroidal anti-inflammatory painkiller. In the new process, there are only three catalytic steps with about 80-percent atom utilization (99 percent when you factor in the recovered by-products). BHC eco-efficiency has been a quiet revolution in bulk pharmaceutical manufacturing. ❀



From EPA Toxic Release Inventory (1994).

Green Chemistry's Maven

An interview with EPA's Tracy Williamson

Tracy Williamson is chief of the Industrial Chemistry Branch, and coordinator of the Green Chemistry Program, at the Environmental Protection Agency.

Tracy Williamson: The Green Chemistry Program started at EPA after the Pollution Prevention Act was passed, in about 1991. The idea was to fund some basic research that could be used by industry to accomplish pollution prevention through chemistry. We were really charged with changing EPA's ethic to one of prevention rather than waste treatment. Our most visible activity is the Green Chemistry Challenge Awards program.

The Green Chemistry Program is entirely voluntary. The Pollution Prevention Act, of course, is a regulation, but it sets forth an ethic rather than regulatory action. We are taking a different approach by working through partnership—a non-regulatory, completely voluntary type of activity.

Green chemistry is a way of bringing back the perspective that chemicals aren't all bad. Of reminding citizens that chemistry is the very basis of the social and economic life of virtually all industrialized nations. Everything around us is a chemical. There are hazardous and toxic chemicals, but also a lot of chemical wonders. So we're trying, through green chemistry, to put chemistry in a very positive light: to show that it can actually be used to solve even our most pressing environmental issues, through the development of alternative technologies. Chemists have the knowledge to design chemical molecules and manufacturing processes that pose little risk to human health or the environment.

We're just starting to make public and lay information available. The American Chemical Society has started, through new editions of existing textbooks. There's a bigger need to develop supplemental materials that faculties can incorporate easily into their current coursework.

Peter Warshall: **Might some of the Challenge awards be kind of perverse incentives to produce a bad product by a less harmful method? Two award winners stand out: Roundup, because of the connection with genetically modified organisms, and CONFIRM, which is questioned by people in the organic food business.**

TW: There are shades of "green." Certainly incremental improvements to one part of a process can be very important, rather than trying to change the entire picture. Making incremental improvements can really add up to significant benefits. At the same time, an entire technology can't be considered green if an improvement made one place results in a negative in another place.

The award actually wasn't for Roundup, it was for the synthetic steps that are used for an intermediate stage in making Roundup. It's a basic synthetic transformation that is used all over the chemical industry to make a whole host of products. There are a number of applications besides manufacture of Roundup where that transformation can be used, with very significant reduction in some very hazardous materials used.

PW: **Monsanto has used it to promote Roundup as a green chemical.**

TW: Some of these are huge issues [genetically modified organisms, organic agriculture]; in the meantime, do we keep using the problem processes to manufacture these controversial

In 1994, more than 26 billion pounds of hazardous chemicals required waste treatment, energy, and materials recycling. More than a trillion dollars have been spent on environmental protection over the past generation.

products? Or do we at least improve the processes with some very significant benefits to human health and the environment? Because that larger issue may never be solved. It certainly isn't going to be solved very quickly.

PW: **We were wondering what happens if you find an environmentally better process that's not cheaper.**

TW: We're finding that in most cases the greener technologies are not only comparable to the old processes from an economic point of view, but in a lot of cases they're preferable. A green process could save millions of dollars per year. That ties back to the costs associated with using hazardous substances; they keep going up. So if you're implementing greener technology, you're avoiding those costs.

PW: **Looking throughout the chemical industry, what would you say is the biggest problem that you would like to see green chemists work on?**

TW: Some existing barriers don't necessarily have to do with implementing greener technologies, but just with implementing new technologies, period. For example, most of the products in the flame retardant industry have been around for a long time. Certainly a lot of polymer-industry processes have been known since the thirties or forties. When you're using the same process over and over, the superiority of a new technology has to be really well demonstrated in order to break in. But again, what we're finding is that it doesn't have to do with greener technologies per se, but with the barriers to incorporating *any* new technologies. ❀

Green Chemistry Access

US Environmental Protection Agency Green Chemistry Program
Office of Pollution Prevention and Toxics, 401 M Street, SW, Washington, DC 20460. 202/260-3960, williamson.tracy@epamail.epa.gov, www.epa.gov/greenchemistry/.

American Chemical Society Green Chemistry Program
American Chemical Society, Division of Education and International Activities, 1155 16th Street, NW, Washington, DC 20036. 800/227-5558, education@acs.org, www.acs.org/education/greenchem.

INCA International Graduate Summer School in Green Chemistry
http://helios.unive.it/inca/summer/index2.htm.

Partnership for Environmental Technology in Education (PETE)
http://nvc.cc.ca.us/~janet/NATL_PETE/fPETE_Programs.html.

Chemical Research Applied to World Needs (CHEMRAWN)
http://iupac.chemsoc.org/standing/chemrawn.html.

EPA and ACS are the prime actors in the fledgling green-chemistry movement. INCA (the Italian Interuniversity Consortium, "Chemistry for the Environment") offers an international post-graduate program in green chemistry annually in Venice. PETE offers workshops to bring green chemistry to faculty and students at community colleges. CHEMRAWN, a standing committee of the heavy-hitting International Union of Pure and Applied Chemistry, is organizing major international conferences on green chemistry.

in Chemistry
$25/year (4 issues). Included free with undergraduate membership ($17) in the American Chemical Society, 1155 16th Street, NW, Washington, DC 20036. 202/872-4480, saprogram@acs.org.

For undergraduate student affiliates; oriented to careers and graduate schools.

Now it's done by sticks (regulations, lawsuits, monitoring). Can it be done with carrots (awards, reduced costs, corporate pride)?

Fighting Fire with Fire

FireAnt Landmine Destroyer

Defence Evaluation and Research Agency, Central Enquiry Desk, Ively Road, Farmborough, Hampshire GU14 0LX, United Kingdom. +44 (0) 1252 393300, www.dera.gov.uk/dera.htm.

Landmines are a nasty piece of human ingenuity. Efforts to ban them continue (see access). In the meantime, millions remain in place, poised to kill and maim. No one knows how many landmines lie buried throughout the world, but estimates range from 85 to 110 million. Every week they kill or injure another 500 people—90 percent of them unarmed civilians, of whom 30 percent are children.

The British Defence Evaluation and Research Agency (DERA) created FireAnt as a safe, cost-effective, mine-clearing tool. The FireAnt is placed close to a mine. After remote ignition, electronically or by fuse, its 1500°C flame burns through the mine's thin metal or plastic casing and burns the explosive and detonator without triggering the mine. The FireAnt itself uses an igniter rather than a detonator, and contains no high explosives; it's designed to be safe to handle and store, with no intrinsic value to terrorists or criminals. —MKS

Incendiary Timeline

900 B.C.E. First recorded use of incendiary weapons in Assyria, though flaming arrows may have a much earlier history.

700 C.E. Black powder recorded in China.

1200 First recorded incendiary warfare using rocket launchers?

1346 Battle at Crécy begins dominance of gunpowder in warfare. Will last 600 years to atomic bomb.

1430 First plate armor from metallurgy.

1866 Alfred Nobel makes dynamite.

1912 Portable flamethrower perfected in Germany.

1936 Soviet and German testing of incendiary bombs during Spanish Civil War. Weapons will be used in World War II.

1945 Incendiary bombing of Dresden and Tokyo (more deaths than Nagasaki and Hiroshima). Invention of napalm and its perfection as anti-personnel weapon. Will be a major factor in all subsequent wars. Atomic-bomb fire.

Holy Suicide

In Hindu and Buddhist traditions, holy self-immolation (voluntary death by fire) is an ancient rite involved in transmigration into a new body. In Buddhism, promoting rebirth as a bodhisattva (a more selfless teacher) and/or as a step into the Buddhist Pure Land can occur by asceticism and "abandoning the body." These devotional and deeply moral holy suicides are done in calm, with others praying quietly in attendance. Self-immolation shocks Westerners, who no longer believe in reincarnation by a passage through fire and who, from this Asian point of view, confuse immortal self with bodily flesh.

Self-immolation is an ancient tradition of spiritual warriors drawing attention to cruelty: soul fire fighting both firearms and the "bezerker" tradition of warrior ruthlessly killing in boiling fury. Alexander the Great's historians tell of the Indian ascetic Kalanos ascending into a burning pyre in front of Alexander and his Greek army. In 1963, in a busy Saigon street, a monk immolated himself to draw attention to South Vietnamese President Diem's anti-Buddhist policies. Five more monks and a nun had repeated the rite by 1965. —PW

Incendiary Access

The International Campaign to Ban Landmines [ICBL]
ICBL Resource Center, PO Box 8844, Youngstorget 0028, Oslo, Norway. +47 22 03 76 93, resource@icbl.org, www.icbl.org.

The U.S. Campaign to Ban Landmines
Vietnam Veterans of America Foundation, 2001 S Street, NW, Suite 740, Washington, DC 20009. 202/483-9222, banminesusa@vi.org, www.vvaf.org/htdocs/landmine.

Ploughshares Fund
Fort Mason Center, B-330, San Francisco, CA 94123. 415/775-2244, ploughshares@ploughshares.org, www.ploughshares.org.

What about the effort to outlaw landmines? An international treaty was signed in 1997. To date, it's been signed by 135 countries and ratified by more than eighty. So guess which countries still aren't on board? For starters: the United States, Cuba, Russia, China, Iraq, Libya, and Pakistan. For updates, see ICBL, which won the Nobel Peace Prize for its work. The US Campaign Web site includes directions for creating educational minefield simulations, and a list of US firms making landmine components. Ploughshares directs grants to concerned groups. —MKS

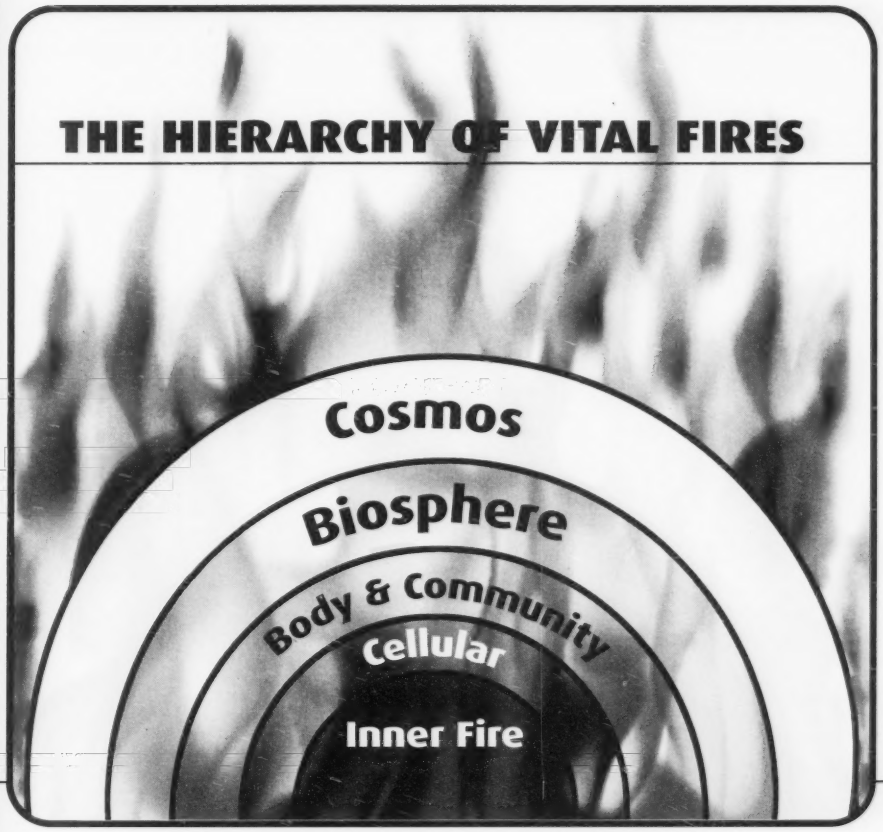
Incendiary Weapons
Stockholm International Peace Research Institute. 1975 (out of print).

The only; the best. Horrific and hopeful.

A History of Greek Fire and Gunpowder
J.R. Partington. 1999; 381 pp. $19.95. The Johns Hopkins University Press.

The classic for the 600 years from gunpowder to atomic weapons.

Science and Civilization in China Vol. 5, Part 7
Joseph Needham, et al. 1986. Cambridge University Press.



COSMIC FIRE is physically created by meteors and novas and the sun. But it's also the eternal play of energy and matter and the belief in an apocalyptic end to it all.

BIOSPHERIC FIRE comes from lightning; land burns for livestock and crops, internal planetary heat, and us.

BODY & COMMUNITY FIRES include sex, firearms, inspiration, hearths, lamps, religious tests of purity, stoves, crafts, heaven/hell, reincarnation, our ideals about landscape fires, ideologies about fire's industrial use, models of "sacred" scientists, fiery speeches, and incendiary war.

CELLULAR "FIRE OF LIFE," which is without flame and invisible, but slow-burns the fuels of life (oxidative metabolism).

INNER FIRE of desires (devotion, love, faith, lust). Here dwell the phenomena of creativity and spirit.

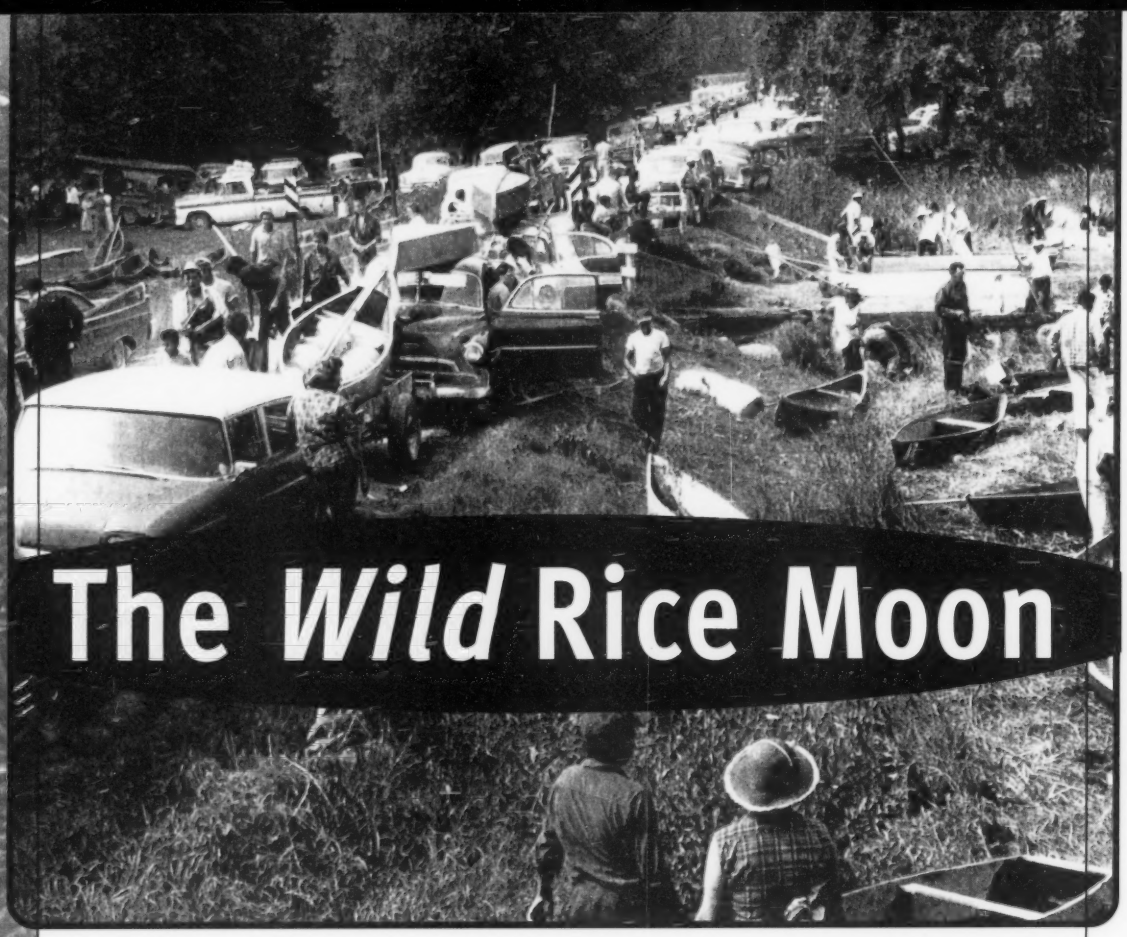
Heat I call it when the mind is truly kindled in love everlasting; and the heart in the same manner, not hopingly but verily, is felt to burn...Song I call it when in a soul the sweetness of everlasting praise is received with plenteous burning, and thought is turned into song; and the mind is changed into full lovely sound... for heat and song cause a marvellous sweetness in the soul.

—The Hermit of Hampole, Richard Rolle
From *Incendium Amoris*, translated in *The Fire of Love*, F.M.M. Comper, ed.; 1920.

Pass the flame, this section's complete.

LINDA CONNOR

Internal combustion engine finds a resting place in biospheric lava.



The *Wild* Rice Moon

GLOBALOCAL MARKETS AND PRESERVING THE TASTE OF *MANOOMIN*

by Winona LaDuke

As the Anishinaabeg Ojibwe tell the story, Nanaboozhoo, the cultural hero of the Anishinaabeg, was introduced to wild rice by fortune, and by a duck.

...One evening Nanaboozhoo returned from hunting, but he had no game...As he came towards his fire, there was a duck sitting on the edge of his kettle of boiling water. After the duck flew away, Nanaboozhoo looked into the kettle and found wild rice floating upon the water, but he did not know what it was. He ate his supper from the kettle, and it was the best soup he had ever tasted. Later, he followed in the direction the duck had taken, and came to a lake full of manoomin*: wild rice. He saw all kinds of ducks and geese and mud hens, and all the other water birds eating the grain. After that, when Nanaboozhoo did not kill a deer, he knew where to find food to eat....*

Manoomin is a centerpiece of the nutrition and sustenance for our community, a gift given to the Anishinaabeg from the Creator. The word *manoomin* itself contains a reference to the Creator, who is referred to as Gitchi Manidoo. In the earliest of historic teachings of Anishinaabeg, there is a reference to wild rice as the food which grows upon the water; the food the ancestors were told to find so they would know when to end their migration to the West. This profound and historic relationship is remembered in the wild rice harvest on White Earth and other reservations. It is a food uniquely ours, a food used in our daily lives, our ceremonies, and in our thanksgiving feasts.

But *manoomin* has left its home, its eastern North American wetland bioregion. From its "homegrown" wild market, wild rice production has spun out into a growing national and small international commerce (the primary markets are for wild rice processed as one ingredient in Uncle Ben's, Pillsbury, and

Above: Ricers gather at Mitchell Dam in Height of Land Township, (Becker County), for the 1961 wild rice harvest. Photo courtesy White Earth Land Recovery Project (WELRP).

Gourmet House specialty products, and for little gourmet bags for specialty shops). There's a Wild Rice Council scouting the expanded markets, particularly in Europe and Eastern Europe. The price no longer varies with rains, drought, hail, wind, and flooding. Commercial competition, especially from paddy "wild" rice grown in California, has entangled our people with the global economy.

Manoominike: Making Wild Rice

It is the wild rice moon, *Manoominigiizis*, in the north country, and the lakes teem with a harvest. "Ever since I was bitty, I've been ricing," reminisces Spud Fineday of Ice Cracking Lake. This year, Spud, with his wife Tater (a.k.a. Vanessa Fineday), started ricing at Cabin Point and then moved to Big Flat Lake; both lakes are within the borders of the Tamarac National Wildlife Refuge. "Sometimes we can knock four to five hundred pounds a day," he says, explaining that he alternates the jobs of "poling and knocking" with his wife.

The Finedays, like many other Anishinaabeg Ojibwe from White Earth (and other reservations in the region), continue to rice in order to feed their families, to buy school clothes and fix cars, and to get ready for the ever-returning winter. The wild rice harvest of the Anishinaabeg feeds the soul, continuing a tradition generations old.

The crispness of early fall touches my face as we paddle through the rice on Blackbird Lake. Four eagles fly overhead, and a flock of geese moves gracefully across the sky. Through the rice, I can see officers of the law ensconced in their work. They are ricing. Eugene Clark (a.k.a. Beebzo), Ogema mayor and Becker County deputy sheriff, and John MacArthur, a Mahnomen County sheriff, are Anishinaabeg. Today they are continuing the harvesting tradition. As they move swiftly through the rice bed, MacArthur knocks and Clark poles. Clark started ricing at 14, and is 53 now. MacArthur, as well, began ricing as a teenager. "We're out here to eat, not to make money," they tell me; they are ricing for their families. That day they bring in a couple hundred pounds of green rice.

It's said that there are fewer rice buyers this year on the reservation, although Beebzo maintains that "there were more people at the rice-permit drawing for (Tamarac Lakes) than vote in most elections." By two weeks into ricing season, Native Harvest (White Earth Land Recovery Project; producer and distributor of Native products) had bought from thirty or forty ricers.

Globalocal Rice

Although new varieties of wild rice have been under study by the University of Minnesota since the 1950s, industrialized "wild" rice did not take off until the late 1960s and early 1970s. Minnesota's paddy wild rice production became aggressive in 1968 (about 20 percent of the market). By 1972, government-supported research led to varieties that wouldn't prematurely shatter when combines harvested drained "lakes." Minnesota's 1973 yield was some four million pounds. The increase in production attracted large corporations (Uncle Ben's, Green Giant, and General Foods), began to skew the perceptions of what was "wild" about "wild rice," and altered the market by representing paddy wild rice as hand-harvested lake-grown.

Once a field is planted to wild rice, it will re-seed itself for three or four years, due to shattering—even in the shatter-resistant cultivars.

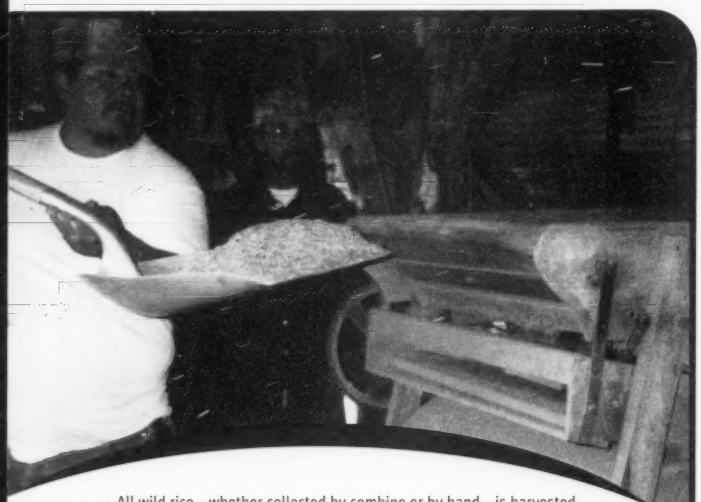
Hand-harvested wild rice in Minnesota must be collected traditionally, by "poling" and "knocking." No motorized boats; one person poles the boat through the harvest waters, the other uses two knockers (long sticks, one in each hand) to sweep through the rice reeds, bend them over the boat, and knock the heads sharply so that the ripest seeds fall out. The reeds spring back and the remaining seeds are left to mature on the stalks. It can take two people a full day to fill a canoe.

Here, Eugene "Beebzo" Clark poles while John MacArthur knocks. Photo courtesy WELRP.

In 1977, the Minnesota state legislature made wild rice our official state grain. That was perhaps the kiss of death for the lake wild rice crop. With an outpouring from the state coffers, the University of Minnesota cranked up its efforts to

develop a domesticated version of the wild rice crop. By the early 1980s, cultivated "wild rice" outstripped indigenous varieties. Ironically, with an it-can-grow-anywhere variety now available, Minnesota lost its monopoly to California. In California, water is bought, not rained down; no wind, no hail. You just put the rice seed in, tend it, and harvest it, pretty much like any other commercial crop.

By 1983, California had produced 8.3 million pounds compared to Minnesota's five million. About fifteen years ago, the federal government paid California white-rice farmers *not* to grow their crop.



All wild rice—whether collected by combine or by hand—is harvested green. After hand-harvesting, traditional wild rice is turned and cured in rows of replenished water to allow the chlorophyll to dissipate, then "parched" in a drum or over fire to remove the moisture and loosen the hulls. (This is when the starches gelatinize and the characteristic nutty flavor develops.) After parching, the rice is "scarified," a process that removes the bran layer. (Traditional scarification uses foot power—stomping—to separate the bran from the seed before it's winnowed.) The exposed seeds are irregular, and can range from yellow to black, depending on the amount of bran lost to scarification.

White Earth Land Recovery Project members Pete Thompson (left) and Pat Wichern are shown putting wild rice into the fanning mill. Photo courtesy WELRP.

Left with flooded fields, harvesting equipment, and an infrastructure custom-designed for rice, Californians turned the government incentive into a galloping "wild" rice cash crop. By 1986, 95 percent of the "wild" rice harvested was paddy grown, most of it in northern California. Flooding the market drove down prices. Minnesotan lakeside prices crashed, devastating the Native wild rice economy. Wild rice had leapt from local to national to global economics, and to a concern for consumers who had no idea who profited or which wild rice still bore the taste of our lakes and muds.

Joe LaGarde, members of the White Earth Tribal Council, and other Indians worry about not just economics but biology. "Man thinks he can improve on something that's been developing over thousands of years. Eventually, he might end up with nothing." Every ricer knows that the wild rice is distinct between lakes. "There's sand-bottom rice (usually shorter grains), muddy-bottom rice, all of that. We're concerned about possible crossbreeding of these hybrid cultivated varieties with our lake rice." The White Earth Tribal Council wrote a letter to the University of Minnesota, asking them to "quit messing with the rice." There appears to be little state regulatory interest in ecological preservation of indigenous wild rice varieties.

As Long As There Is Wild Rice, There Will Be Ricers

A pickup pulls up at the rice mill, and Eugene Davis and Tony Warren bring in around 300 pounds of rice off South Chippewa Lake. They are tired, wet from the recurring rain of morning, but happy. "I like it when it rains out there," 19-year-old Eugene tells me. "It's nice; you can't hear anything but the rain." It is that peace which brings the ricers back. It is also the memories. I ask Eugene what he thinks about the fact that probably five or ten generations of his family have been on that same lake. "I like knowing that they was on the same lake, it makes me feel good," he responds, and smiles.

Receiving the rice are Ronnie Chilton, Pat Wichern, Pete Thompson, and a few other men who gather under some tarps at the offices of the White Earth Land Recovery Project on Round Lake. The sweet smell of parching rice wafts through the dusty air. Ancient machines shift and creak as the husks blow off and the rice slowly moves through a long chain of events, at the end of which the shiny dark green, tan, and brown wild rice glimmers in the September sun. The equipment is virtually antique, and much of it handmade: a 1940s Red Clipper fanning mill, a handmade thrasher, a 1980s set of George Stinson's parching drums (George is a Deer

What *Is* Wild Rice?

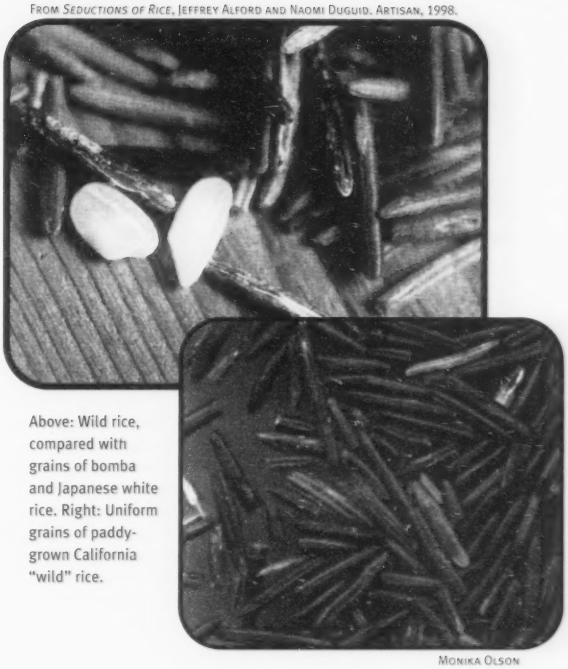
Not rice, for one thing. Mistakenly associated with oats and called *folle avoine* by the first French explorers, mistaken for and named wild "rice" by early English explorers, *Zizania* is really an aquatic seed grass. There are four species; two are annuals, including our field crop, *Z. palustris*. A clever grass, this: Its seed panicle produces seeds that mature at different times—some early, to miss the frost, some late, to evade migrating birds that gorge on the energy supply as they wing through in the fall. —NP

River celebrity), a 1950s-vintage gravity table. (Most newly produced equipment is for the large operations—like those in California, not here.) The men fiddle around with the machines, fine-tune the gravity table. The air is filled with the dust from the rice. Ronnie, Pat, and Pete look a bit like Anishinaabeg chimney sweeps, covered in rice hulls, but smiling beneath all of it. They are local producers, and this is the quality perfection of the small batch, and the simple joy of this life. They are doing their job, and that rice, like that of their ancestors, is going to feed families, and feed spirits.

To Pat, Ronnie, Spud, Tater, and the rest of the ricers of White Earth, the Ojibwe Wild Ricing Moon is the season of a harvest, a ceremony and a way of life. "I grew up doing that," reflects Spud Fineday. "You get to visit people you haven't seen for a whole year, because just about everyone goes ricing." Far away, a combine is harvesting wild rice somewhere in California, and consumers are eating a very different rice. The Anishinaabeg would not trade for that rice, or for the combine. In the end, this rice right here tastes like a lake, and that taste cannot be replicated. ❀

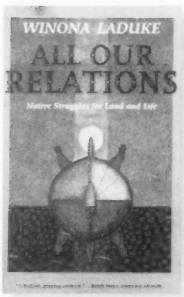
Winona LaDuke is a member of the Mississippi band of the Anishinaabeg. She is Founding Director of the White Earth Land Recovery Project. Her most recent book is ***All Our Relations*** (see below). Her speeches rivet, and even *Time* named her one of America's most promising young leaders. She served as Ralph Nader's Green Party running mate in the 1996 presidential campaign. She and the Indigo Girls shared the *Ms.* magazine Woman of the Year award in 1997. —PW

From *Seductions of Rice*, Jeffrey Alford and Naomi Duguid. Artisan, 1998.



Above: Wild rice, compared with grains of bomba and Japanese white rice. Right: Uniform grains of paddy-grown California "wild" rice.

Monika Olson



All Our Relations
Native Struggles for Land and Life

Winona LaDuke. 1999; 241 pp. $16. South End Press

As a graduate student in the mid 1960s, I tried to teach Native-American history within the Anthropology Department at Harvard. They wouldn't accept a course that followed native peoples from earliest archeological evidence to 1960. To be ethnographers, we had to stop at the end of conquest, about 1870 to 1900. After that, Native Americans were considered too acculturated to be of interest. Instead, the Law School sponsored the class; of twenty students, fifteen were Native Americans. To put it mildly, I became the student.

This is the book I would have used had it existed thirty-five years ago. Eight portraits of Native-American peoples refusing to make distinctions among spirit, politics, land, and all life. A sense of faith and deep continuity on Turtle Island, our continent ravaged by invasion and time. Mohawk moms and PCBs; dams and the Nitassinan; Western Shosone and nuclear wastes; the Buffalo peoples and the loss of buffalo. No ragtag remnants of lost cultures here. Strong voices of old, old cultures bravely trying to make sense of an Earth in chaos. —PW

Wild Rice Access

How Do I Know What I'm Buying?

You generally don't—except in Minnesota, where commercial and Native wild rice producers achieved détente and got together to push for labeling laws. Commercial growers in that state wanted to distinguish Minnesotan wild rice from any other. Native growers, with a more labor-intensive process—and because hand-harvested wild rice has considerable market cachet, and is in smaller supply—needed labeling to justify a premium price. —NP

North American Native Wild Rice Industry Preservation Club
Grey Owl Foods, PO Box 597, North Hampton, MA 01061. 413/584-3013, jmccool @greyowlfoods .com, http:/ /greyowlfoods.com /goprevclub.html.

Grey Owl markets both commercially grown wild rice and natural lake and river wild rice to stay competitive in world markets. One of the company's stipulated goals is to preserve what it sees as a fragile North American Native wild rice industry. —NP

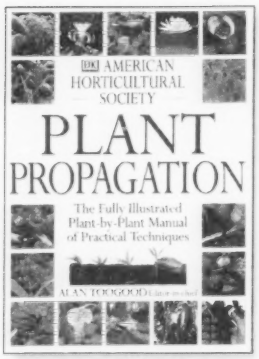
White Earth Land Recovery Project/Native Harvest
32033 E. Round Lake Road, Ponsford, MN 56575. 888/779-3577, WELRP@eot.com.

Indian Harvest
PO Box 845, Bemidgi, MN 56619. 800/294-2433, www. indianharvest.com.

Wild Rice Home Page
http://indy4.fdl.cc .mn.us/~isk/food /wildrice.html.

Minnesota Cultivated Wild Rice Council
1306 W. County Road F, Suite 109, St. Paul, MN 55112. 651/638-1955, mnwildrice @aol.com.

(With generous assistance from Irv Elke, University of Minnesota Department of Agronomy and Plant Genetics; Kevin Edberg, Minnesota Department of Agriculture; and Jon Dockter, Minnesota Cultivated Wild Rice Council.)



American Horticultural Society Plant Propagation

The Fully Illustrated Plant-by-Plant Manual of Practical Techniques
Alan Toogood, ed. 1999; 320 pages; $34.95. DK Publishing.

Plants have developed so many complicated and specialized strategies for reproduction, and horticulturists have developed so many techniques to mimic those strategies, that even home propagators are unlikely to find all of the guidance they will ever need in one book. But home gardeners will find this the most comprehensive single volume on the art of increasing the number of plants you want in cultivation.

Among the most widely consulted and consistently dependable of such books have been *Secrets of Plant Propagation*, by Lewis Hill (one of the American Horticultural Society's Seventy-Five Great American Garden Books); *The New Seed Starters Handbook*, by Nancy Bubel (a wise guide through the entire process of germinating seed); and *Park's Success with Seeds*, by Ann Reilly (over twenty years old, but its photographs of seedlings are unique and invaluable). *American Horticultural Society Plant Propagation* has muscled its way into this excellent and well-tested company with a big book that sorts out hundreds of complicated topics. Visually it is unbeatable. Every page is filled with lively, confidence-building photographs of techniques as basic as division of perennials and as advanced as rind grafting of fruit trees. It covers general propagation methods by major plant group, and describes techniques—rated easy to challenging—for more than 1,500 plants. There is more instruction specific to individual plants than Hill's, Bubel's, and Reilly's books put together.
—Patricia Jonas

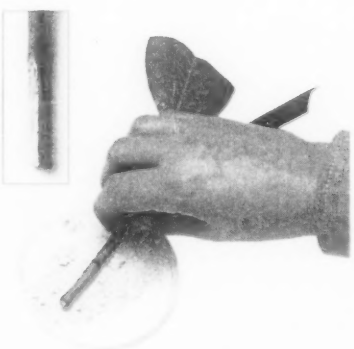
"Breeding a commercially successful and stable hybrid is usually an expensive and laborious task, but the amateur gardener can have fun experimenting with this technique. Some genera, such as dahlias, irises, or roses, lend themselves to hybridizing on an amateur scale, often producing quite pleasing seedlings. Indeed, many hybrids that are now on the market were originally produced by amateur gardeners.

Home hybridizing is not very complicated but requires a methodical approach and a great deal of patience. It helps to concentrate on one species or genus. Have a specific aim, say to produce larger-flowered red-hot pokers that are hardy to -36°F (-20°C) or a range of double-flowered Oriental poppies. Do some research to find out if any of the characteristics that you are aiming for in the hybrid are evident within the species or genus. Then select parents that may be of interest and start hybridizing, crossing and backcrossing, selecting and reselecting the progeny.

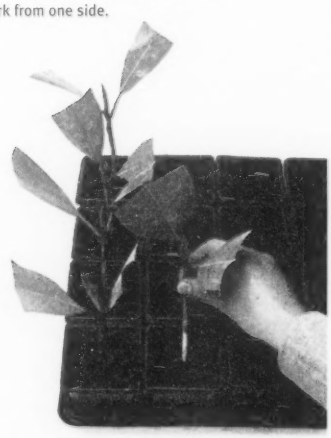
Taking semi-ripe cuttings of trees:

1. Select a healthy shoot (soft at the tip, firm at the base) from the current season's growth. Using pruners, cut straight above a node to obtain a cutting 4–6 in (10–15 cm) in length. (The tree shown here is a magnolia.)

2. Remove all except the top two leaves; cut these two in half with a sharp, clean knife to reduce moisture loss. To stimulate rooting, wound the base of the stem by slicing off a 1 1/4 in (3 cm) sliver of bark from one side.



3. Dip the wounded stem in a small amount of hormone rooting powder (or gel), and tap off any excess (see inset). After all cuttings have been treated, discard any leftover compound.



4. Using a mixture of equal parts peat and fine bark, make a 3–4 in (8–10 cm) hole in each pot. Insert cuttings so they stand upright; firm the soil around each stem; label; and water.

The Rose's Kiss

A Natural History of Flowers

Peter Bernhardt. 1999; 267 pp. $24.95. Island Press.

During this century, botany has taken a back seat to other sciences. By the fifties, most students would have agreed that the great discoveries had been made, and that it was an irrelevant subject taught in a dead language. In *The Rose's Kiss*, Peter Bernhardt observes that most otherwise scientifically literate adults now know less about botany than did typical schoolchildren a hundred years ago. For many of us—particularly gardeners—botany was the arcane business of renaming and reclassifying plants, until the hubbub over genetically engineered crops and Earth's loss of biodiversity put botany in the news.

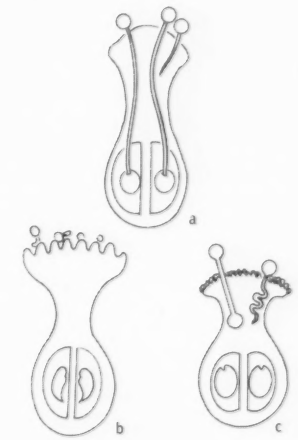
So it is eye-opening to read Bernhardt describing contemporary discoveries in the sex life of plants. Botanists only recently observed, for instance, that besides the attractions of scent and color, some flowers offer pollinating insects a warm bunk by chemically generating heat. We have been making perfume for more than 5,000 years, but experiments to discover how and where flowers produce their scent only began in the fifties—after the introduction of the electron microscope. Bernhardt is not just a collector of natural curiosities; he is an enthusiastic and entertaining writer who quotes D.H. Lawrence as well as Darwin, and who sees poetry in the natural history of flowers. —PJ

"The Asian sacred lotus (*Nelumbo nucifera*) has long been admired for its large pink-and-white flowers, but botanists now know that each flower has its own thermostat. A single lotus bloom can produce and sustain a temperature of more than 80 degrees Fahrenheit even when the air temperature sinks to 50 degrees.

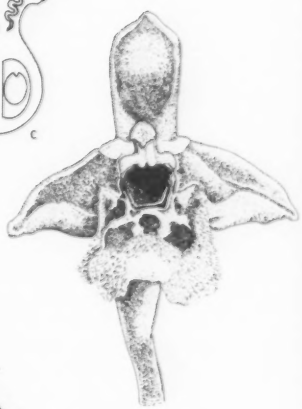
Half of the heat in a lotus flower is generated by a spongy, cylinder-shaped structure in its center called the receptacle....A lotus "fires up" when it is a mature bud, just before its petals expand. Temperature equilibrium is reached when the rate of heat production in the flower equals the rate of heat loss. For a few days, the flower regulates its temperature as would a small warm-blooded animal such as a hummingbird or shrew. Scientists believe that a floral temperature of 80 degrees Fahrenheit may make it easier for a cold-blooded insect to activate its flight muscles. This would speed up the rate of cross-pollination, allowing warmed, energetic beetles or bees to hurry from bloom to bloom even when the weather is cool and uninviting.

"Ancient frescoes discovered in Egypt and on the island of Crete suggest that humans have farmed flowers for their fragrance for more than five thousand years. The Madonna lily (*Lilium candidum*) appears to be one of the oldest perfume crops in the Mediterranean region. Some paintings in Egyptian tombs depict ladies of the pharaoh's court wearing unguent cones on their foreheads. Recipes for making these scented cones have been translated from surviving scrolls. In most cases, pounded or chopped petals were mixed with ox fat.

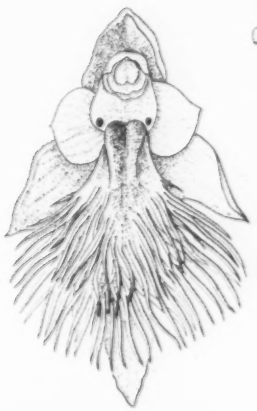
The perfume industry guards its secrets jealously because they are so lucrative. This makes it harder for science writers to piece together a natural history of flower scents. Scientists do know, however, that fragrant chemicals make up only a fraction of a live flower. Scent compounds make up just 0.075 percent of the weight of a fresh rose.



Left: *a.* Tubes sprouted from pollen grains grow down the style to penetrate the ovary. Sperm is delivered from a surface channel. *b.* "Neat" self-incompatible plants foil the system at the surface. *c.* "Sloppy" self-incompatibles abort the process midway down.



A bee orchid (*Ophrys holoserica*), from Israel.



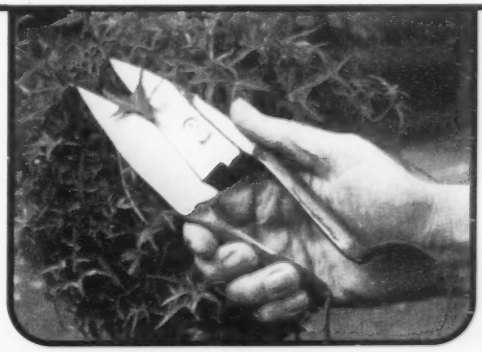
The old man orchid (*Calochilus campestris*) of Australia.

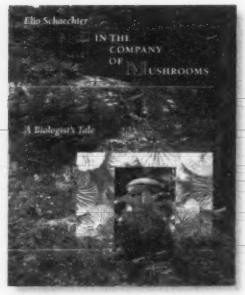
Both these orchids mimic female insects to lure pollinating males to their lip petals. They alter the petals' texture with sculptures, hairs, or both.

Sheep Shears for Harvesting Seed and Pruning Plants

$29.95 ($36.45 postpaid). Kinsman Company, Inc., The Old Firehouse, River Road, Point Pleasant, PA 18950. 800/733-4146, 215/297-0890, www.kinsmangarden.com.

Not long after reading in the November 1998 *Ecology Action Newsletter* (5798 Ridgewood Road, Willits, CA 95490) that a pair of sheep shears is the "favorite tool" of John Jeavons and other biointensive gardeners for harvesting grain, alfalfa, and comfrey, we received a press release from the Kinsman Company, Inc., publicizing their hand-made English sheep shears, "the answer for clean, precise cutting and clipping of soft herbaceous growth. Deadheading, too. They are ideal for clipping and edging grass." —*HortIdeas* (750 Black Lick Road, Gravel Switch, KY 40328)



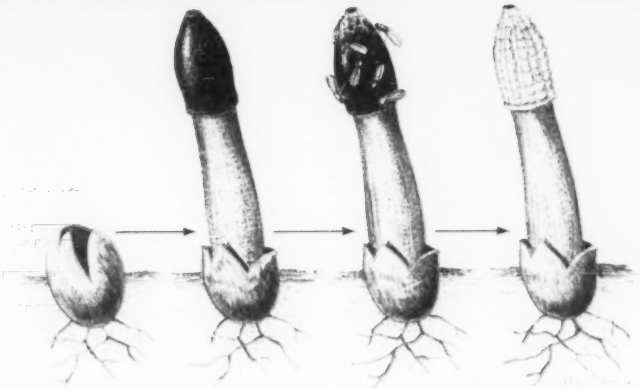


In the Company of Mushrooms
A Biologist's Tale

Elio Schaechter. 1997; 280 pp. $24.95. Harvard University Press.

I run into so many people who know so much about nature—how to tell birds by their songs and wildflowers by their smells—that I am always saddened by how little they know about mushrooms, a kingdom they could hardly live without. Elio writes about how mushrooms work their magic, how they secure their living, and how we benefit from having them as our planetmates. For people who want to want something other than a field guide or a textbook, this is the book—well organized and well written. And the author has a congenial way of inviting you to join him on his excursions through the world of mushrooms. He is positively lyrical about mushroom hunting and the pleasures awaiting you on your next walk in the woods. He writes with the passion of a gourmand about edible mushrooms, and with that of a Sherlock Holmes about poisonous and hallucinogenic ones. Hard to resist.

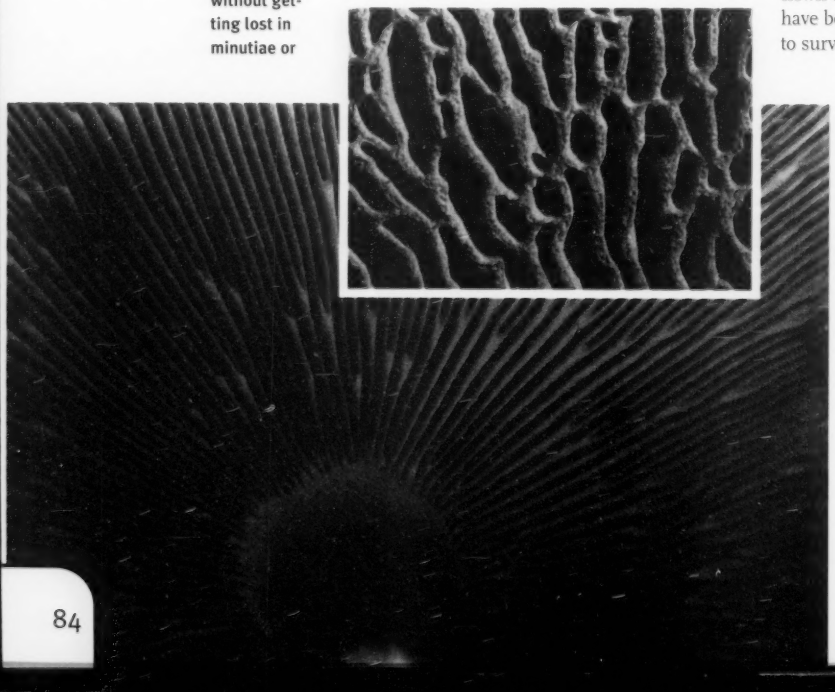
I use this book in my classes. Elio has the ability to discuss something difficult, like fungal sex, without getting lost in minutiae or jargon. There's an excellent annotated bibliography, as well as contact information for mushroom clubs around the country. You can also contact the North American Mycological Association: www.namyco.org. —Gary Lincoff

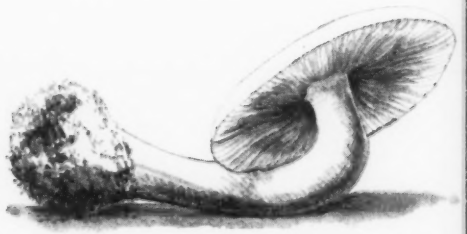


The stinkhorn (*Phallus impudicus*) develops in a few hours from the "egg" stage to the malodorous mature form that attracts insects.

"Counterintuitive as it seems, extensive fungal colonization may be helpful to a host tree. Fungi do not usually invade the living sapwood, where the growth of the tree takes place; for the most part, they confine their spread to the dead heartwood, the central portion of the tree. Fungal growth leads to decay of the heartwood and, in time, to the hollowing out of the tree, turning it into an empty cylinder. A hollowed-out tree may actually become more resistant to high winds than a solid one, which is more unbending and heavier....Ancient oaks, gnarled and hewn out inside, have been known to survive for 500 years or more, and some damaged-looking sequoias and redwoods are even older.

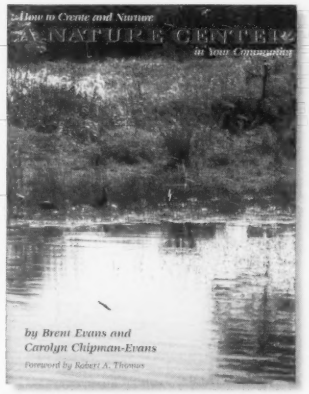
"In our native woods there grows a kind of toadstool, called in the vernacular The Stinkhorn, though in Latin it bears a grosser name. This name is justified for the fungus can be hunted by the scent alone; and this was Aunt Etty's greatest invention: armed with a basket and a pointed stick, and wearing a special hunting cloak and gloves, she would sniff her way round the wood, pausing here and there, her nostrils twitching, when she caught whiff of her prey; then at last, with a deadly pounce, she would fall upon her victim, and then poke his putrid carcass into her basket....The catch was brought back and burnt in deepest secrecy on the drawing-room fire, with all the doors locked, because of the morals of the maids!" [Gwen Raverat, a niece of Charles Darwin]





Above: An *Amanita* rights its cap after having been placed on a table sideways for ten minutes.

Left: Mushroom gills.



How to Create and Nurture a Nature Center in Your Community

Brent Evans and Carolyn Chipman-Evans. 1998; 250 pp. $26.95. University of Texas Press.

With every new electronic technology or added freeway overpass, retreating to nature feels more crucial for our peace of mind and well-being. Nature centers provide just such a refuge from techno-industrial society, and with the Evanses' new how-to manual, still more centers may open. Well organized and complete, their book is neither too vague nor overly directive. Numerous excerpts from newsletters, mission statements, and budgets provide specific examples of documentation from different nature centers. Several extremely useful appendices list relevant organizations, publications, and nature centers across the country. Anyone even considering opening a nature center needs to get his or her hands on this manual. In addition, it will benefit the staffs of existing nature centers, botanical gardens, community gardens, ropes courses, or other outdoor institutions. —Geoff Ruth

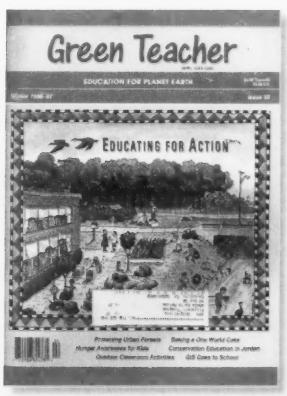
"Many nature centers have been born out of a community's desire to preserve a piece of natural beauty forever. Helping a bit of wilderness stay wild may seem fairly easy to the novice, but there is much more to nurturing wilderness than just leaving it alone. What constitutes wildness? Should invasive plant species be allowed to flourish, or should they be eradicated, and how? Which species are "native," and which are "naturalized"? Should the public be permitted in all areas, no matter how fragile? How should motorized and foot traffic be controlled ? Could this public natural setting be literally "loved to death"?

"The beginning of a nature center is always in the heart of a visionary. Soon that vision spreads, and interest builds....The journey is yours, and you can take it in your own way, at your own pace.

"As you try to put a price tag on projects like trails, interpretive signs, educational programs, and improvements, we suggest having two budgets: a dream budget and a bare-bones survival budget.

Left: Local children often have the scoop on ideal natural sites.

Below: A trail guide teaches the gentle art of butterfly netting for a monarch count.



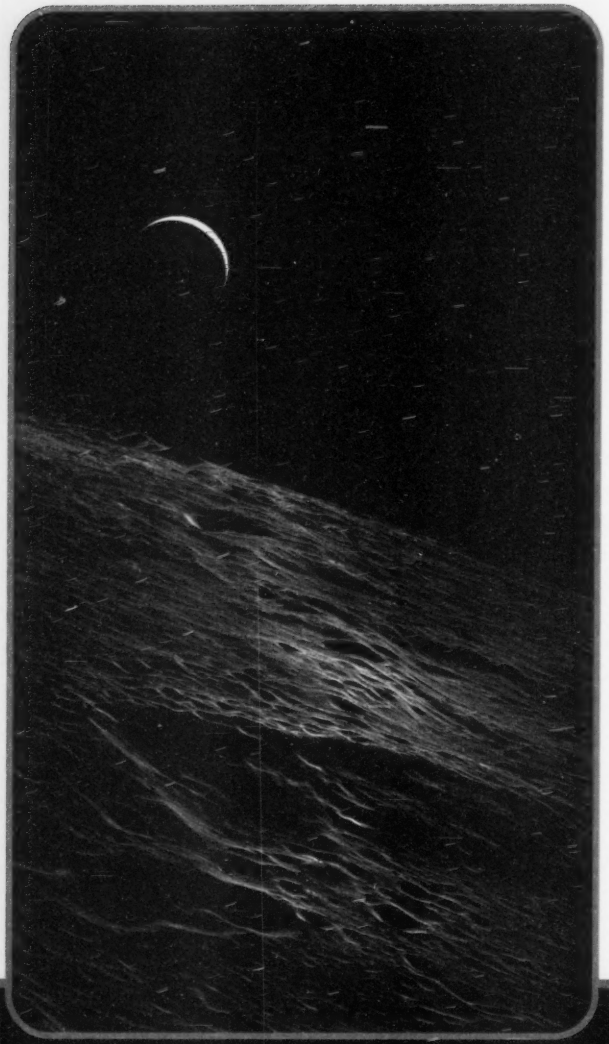
Green Teacher

Tim Grant and Gail Littlejohn, eds. $22/year (Canada $25/year) (4 issues). 95 Robert Street, Toronto, ON M5S 2K5 Canada. 416/960-1244, greentea@web.net, www.web.ca/~greentea/.

For teachers and environmental educators, this quarterly magazine is dense with classroom activities and resources. As a busy teacher, I appreciated the succinct and clear resource listings and curricular activities. I liked the inclusion of social justice activities alongside environmental curricula. The feature-length articles are more mixed: some are provocative and innovative, while others seemed unoriginal or academic. Still, their brevity and *Green Teacher*'s well-organized design makes it easy to scan to find what is most helpful. —GR

"The close connection between the problems of hunger and environmental degradation result in a chronic cycle of misery for many people in the world. Why teach children about such a huge and depressing problem as world hunger? It is a legitimate question. Yet learning about the causes of hunger can be an empowering process in which students acquire a better understanding of the world and learn the skills needed to make a difference. In addition, teaching children about world hunger is an avenue to teaching them so much more: about other cultures, nutrition, government, ecology, geography, and current events.

"Life Like a River: Discuss the concept of watersheds and the idea that rivers and lakes develop characteristics which reflect the "journeys" of the water flowing into them. Extend this concept to consider "cultural watersheds." How did people "flow" to this place? What experience did they have in getting here? How does the community reflect the characteristics of the people living there? Visit a river or stream and compare in writing the role and growth of the river with your own....What are the signs of its age? How is it viewed? Who depends upon it?...At this point in your life, how are you viewed? What are your responsibilities? Who depends on you?



A slender crescent Earth rises over the lunar highlands in a composite of two images made at an altitude of seventy miles. 70mm transparency by Alfred Worden, Apollo 15.

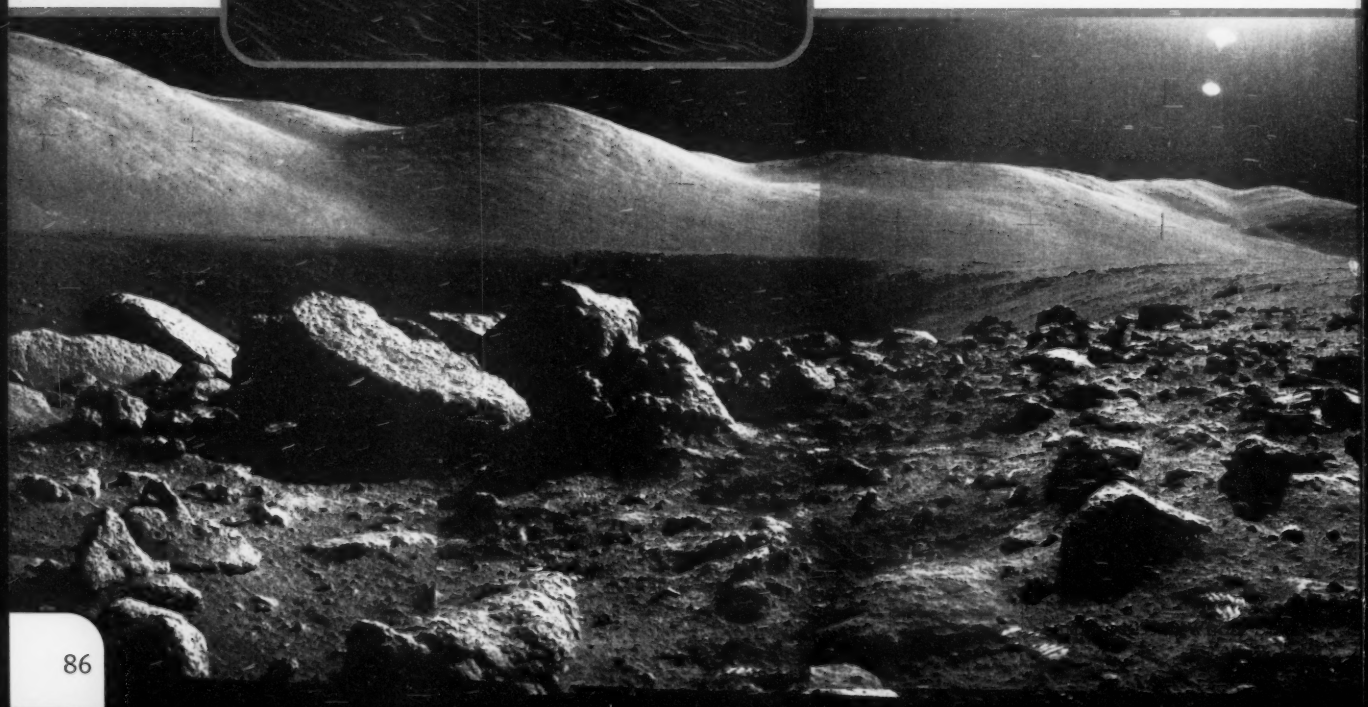
FULL MOON

Full Moon

Michael Light. 1999; 244 pp. $50.
Alfred A. Knopf. (Suggested by Linda Connor.)

Full Moon is a gorgeous book, right up there with the best coffee-table books on space. Indeed, no other book of space images competes with the quality of the photographs here. The book is decidedly and purposely "unbalanced," giving priority to the unparalleled images from and about the moon. This imbalance reflects Michael Light's conviction that the reader (seer?) will be transformed and transported, as he was, on seeing really high-quality images from the Apollo lunar missions.

Light's determination to let the images speak for themselves is impressive. He got special permission from NASA to digitize the master duplicates of the original film; previous publishers had to make do with fourth- and fifth-generation duplicates. There are no captions. The pages are



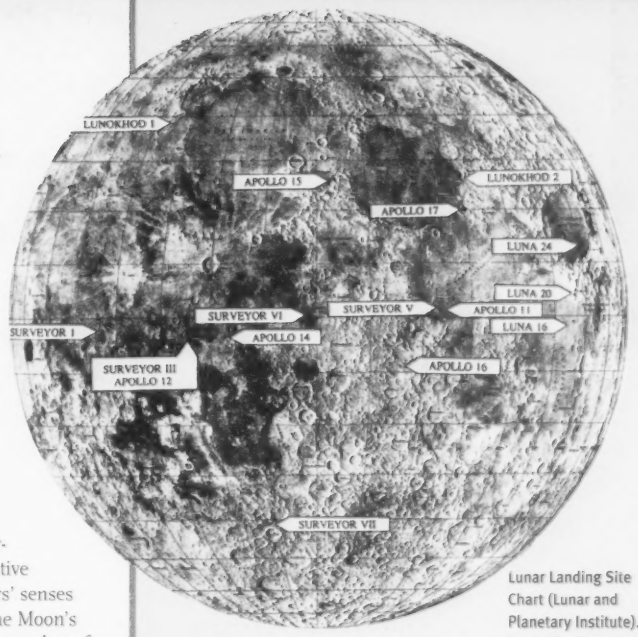
unnumbered. The background is matte black. Not until the back of the book does Light compromise the visual with words—a compact though excellent description by Andy Chaiken of the astronauts' experience of going to, being on, and returning from the moon, and a few words by Light on the why and how of putting the book together.

The book shows great respect for the reader. While the thumbnail index at the back of the book answers most basic questions about each of the images, *Full Moon* immerses the reader in the visual experience of the lunar astronauts. This is to most photo books as IMAX is to movies on my VCR. —Russell L. (Rusty) Schweickart, Apollo 9 astronaut

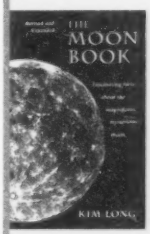
❝ Asked to explain why the Moon is beautiful, the astronauts struggle to find the right words. The difficulty is understandable. The moonwalkers saw vistas that were literally alien, a quality that was epitomized by the lunar sky. On Earth air molecules scatter sunlight and turn the sky blue. But on the airless Moon there is only the blackness of space. This, said Apollo 15's Dave Scott, creates a visual stimulus unknown on Earth. "Most people can't comprehend a black sky except at night," Scott explained, adding that the moonwalkers "can comprehend a black sky in the daytime. And it's very different from a blue sky. When the surface of the Moon is illuminated, and it's bright, there are shadows, and contrasts, and so on....And above that, it is a black sky—that is a whole new thing for the mind to handle." To Apollo 16's Charlie Duke, the blackness was so deep as to seem tangible. "You feel like you can go over there and it's a black velvet screen...that you can just reach out and touch it," Duke said, "and yet there's nothing there."

❝ But one fact in particular—the Moon's diminutive size—filled the moonwalkers' senses with an unearthly reality. The Moon's diameter is roughly one-quarter that of the Earth, something Apollo 11's Buzz Aldrin said he could actually determine with his own eyes. Looking out at the plains of the Sea of Tranquility, he remembers, he could see the ground curving gently away from him. The effect was subtle—nothing like standing on the knoll of a hill—but Aldrin said his eyes and intellect combined to tell him, "Gee, it is really obvious that this is a sphere that we're...walking on."

Geologist-astronaut Harrison Schmitt bounces across the Taurus-Littrow valley in this composite (left to right) of the Sculptured Hills, the East Massif, Bear Mountain, and the South Massif. 70mm transparencies by Eugene Cernan, Apollo 17.



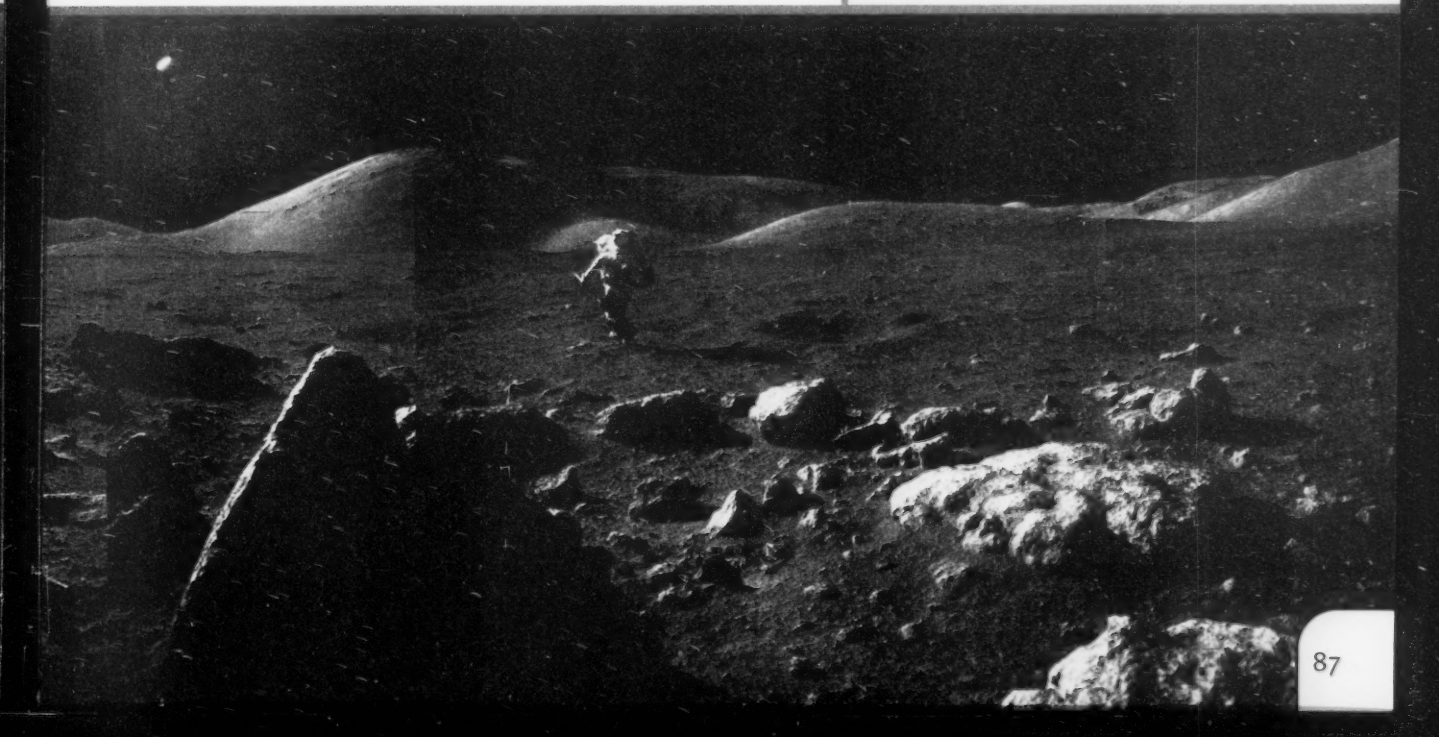
Lunar Landing Site Chart (Lunar and Planetary Institute). From *The Moon Book*.



THE MOON BOOK
Fascinating Facts about the Magnificent, Mysterious Moon

Kim Long. 1998 (revised and expanded ed.); 149 pp. $12.50. Johnson Books.

Lunar statistics, phases, tilts, occultations, surface features, rules of thumb for viewing and photographing, names in different languages for seasonal moons, everything but green cheese recipes and rhymes for June and croon. If it's not here, you probably don't want to know it. —MKS



Wow! The Earth!

JUST A LITTLE E-MAIL FROM A GUY IN OUTER SPACE

BY DAVID A. WOLF, *MIR* SPACE STATION ASTRONAUT

Below: Big space shoes to fill: Astronaut David Scott, Apollo 9 (1969), floats in the hatch of command module *Gumdrop*. 70mm transparency by Russell Schweickart. From *Full Moon* (see page 86).

October 31, 1997. After finally learning where to find critical items like the self-closing trash-container liners, I think it is safe to say that I am settling in up here. One of the things I am learning is that you don't have to be a rocket scientist (even though that is what we are) to make a real difference on *Mir*. Between operating a full-time lab module and pitching in on the daily ship's chores, I hardly have time to write my letters home. Don't take that as a complaint. There's no place on Earth I would rather be.

Because the crews before us were so busy fighting alligators, it's now up to us to return this remarkable ship into top shape. Unfortunately for me, that means things like organizing and cleaning, tasks my mother can attest that I didn't always excel at back on Earth. But she sure would be proud of me now. I spent most of today in the bathroom—organizing and cleaning it, not using it. Yesterday I spent the morning capturing the water that accumulates as big wiggling, floating blobs on the heat exchangers of our condensate recovery system.

My pet project is keeping the numerous ventilation filters clear—no small order. I also have been put in charge of the local lost and found. Because I helped stow the gear from the *Progress* supply ship, Pavel and Anatoly think I actually remember where I put everything. But even if that were true, unlike on Earth, up here things don't necessarily stay where you put them. If you don't nail it down (up here we use Velcro) there is literally no telling where something will float.

...But mainly my time is spent in the laboratory module, *Priroda*, which means "nature" in English. It's a capable lab....It keeps me so busy I can't imagine having yet another module (would have been *Spektr*) full of experiments. A great colleague of mine said that a lab is a place with enough junk in it to do anything. We're there.

This ship literally reeks of both history and character. It's a "fixer upper" all right, but one you would take a long trip with in a heartbeat. The central command post (cockpit) has keys that look like worn ivory. Leather shrouds serve where plastic would now be chosen. The metal machining is recognizably Russian, and of the highest quality. Its overall character brings forth the image of the "time machine" from H. G. Wells's classic. Signatures and instruction placards written by the hands of over a decade of cosmonauts who maintained and lived in this true marvel of human achievement. Adapted over the years to the unforeseen requirements of zero-gravity life. Tables with things on both sides. A bicycle with no seat. A set of heavy tools held in place by rubber bands. A network of bungees and cables suited ideally to gravityless locomotion and stowage. Spider-Man would be envious.

I ate dinner with my eyes closed while listening to music recorded at a Russian cafe on Tverskaya. Apparently it takes longer than three weeks to get totally used to no gravity. I still look up at the gas analyzer on the ceiling and wonder, for a moment, how I'll get up there to read it and find myself momentarily surprised to discover that I can just fly on up. I continue to try and put something "down," foolishly thinking it might stay put....I get my hands too full, and then am a bit slow to simply let go and then sort it out. I also forget to use the ceiling as a surface. The other morning Pavel was in my path for several seconds before I remembered I could just float over him to get where I was going. We show off to each other the intricacies of body control, in the proper form, as dictated by

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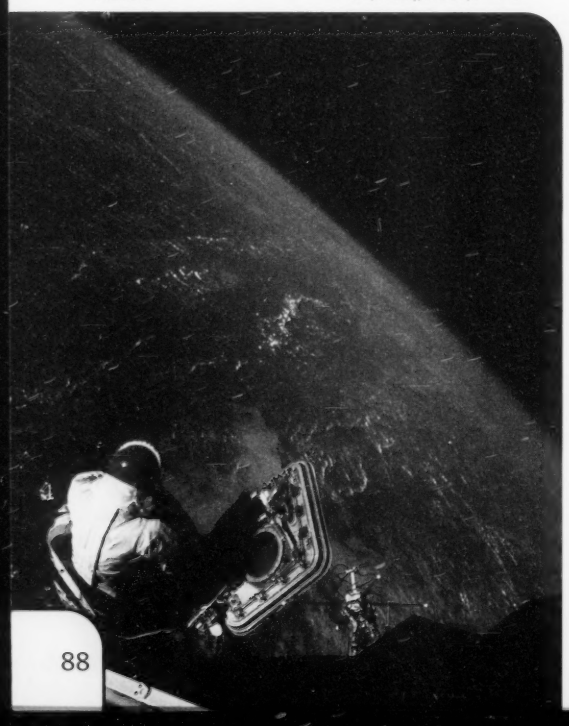
Dr. David A. Wolf lived in the *Mir* Space Station for 119 days, after training for a year at the Yuri Gagarin Cosmonaut Training Centre in Russia.

As USAF senior flight surgeon, weapons system officer, chief engineer for the design of NASA's Space Station medical facility, and tissue engineering technology specialist, David Wolf felt prepared for the *Mir* mission.

But he may have been better prepared as the kid from Indianapolis, with a wry Midwestern humor; as board member of the National Inventors Hall of Fame; and as sport aerobatic pilot, scuba diver, and water-skier with flexibility for zero-g. Letters, mission reports, and interviews can be viewed at http://spaceflight.nasa.gov/history/shuttle-mir/mir24/status/. —PW



current zero-gravity style. These are competitions I invariably lose. I am still trying to figure out how not to become upside down when putting my pants on. Don't worry though. I have plenty of time to figure it out.

Dave

November 14, 1997. Back of the envelope calculation: I've traveled roughly 17 million miles since we left the crew quarters at Cape Kennedy, not including the van ride to the pad....In fact, Earth seems a bit dreamlike these days, as we are connected only by crackling voices on the radio and the photographs brought along and our memories.

Today...I awake against the ceiling of a densely packed storage area of the *Krystall* Module of Space Station *Mir*. It's the place where I have been temporarily sleeping while spacewalk activities are underway in my usual "cabin," the *Kvant* backup airlock. Pushed a space-shuttle-delivered water bag away from my face. Fumbled in the blackness of the night side for that spot of Velcro holding my mini-Maglite and Sony Discman. Faintly heard it still repeating "Dark Side of the Moon." Floated out of the marginally tethered sleeping bag and banged my head on the helmet of a ragged old spacesuit, long since cannibalized for parts. Cranked open the micrometeoroid cover of the heavy quartz window and, wow, there's Earth.

Hit me like the first time I ever saw it from space. Ghosty outlines of continents just illuminated by the half moon. At an unfelt five miles per second, we blow out of the Earth's shadow and into the harsh unattenuated sunlight. Solar arrays alertly take notice and rotate precisely into position to capture a bit of this fortuitous energy. We blaze over that moving line on the Earth that separates night from day. The dominant features on the planet below are two tectonic plates. One holding the Tibetan Plateau and the other, India. The plates are clearly smashing together, incidentally elevating the Great Himalayan Mountain Range. Eyes now adjusting, looking real close, there, snow-covered Mt. Everest and Katmandu. It's a rare clear day over France, England, and Italy. Hazy, even smoky, into China and southern Siberia. Some large smoke plumes, a lot of forest clearing going on there. Just ahead, to the east, the incredible blue Lake Baikal, perhaps the biggest lake in the world. Set like a gem stone into the Earth's crust....

Above: Walter Schirra commanded Apollo 7 in 1968, setting the stage for the future of manned flight. 70mm transparency by Walter Cunningham, Apollo 7. From *Full Moon* (see page 86).

Pulling myself through a tightly packed passageway in the *Krystall* Module, I stop to retether a loose food container. Look over at the module's main control panel and note the familiar pattern of lights. All in order here. Untangle my earphone wires stubbornly hanging me up. This time in one of the power cables to a portable ventilator fan. It was necessary to set it up a few days ago to clear carbon dioxide from this temporary sleeping area. In space, without gravity-driven convection, the atmosphere is dead still. Without fans there is not enough mixing to deliver oxygen, clear CO_2, or even carry the metabolic heat away from our bodies. A clanky traversal, thirty or so feet, takes me through a three-dimensional attic swimming with spare pumps, computers, radio gear, waste containers, 800-amp batteries, oxygen candles, cables...the supplies that make this space station temporarily free from Earth's support. The warehouse of parts that, when combined with amazing human resourcefulness, have allowed this space station to operate continuously, in space, for over eleven years.

I scrape free into the central docking node. As usual, hands already too full. A flashlight, rehydratable soap, CD player, radiation monitor data disk, a bag of trash, and the opposite wall coming up fast. The docking node is the structural backbone of the station, firmly holding the six main spacecraft modules in position. Can't help but take an eerie glance at the sealed off *Spektr* Module hatch. *Spektr*'s solar arrays still tirelessly search for the Sun and send power for the rest of the station. Likely, humans will never venture back into this airless laboratory....

Morning rounds. First, I assemble our improvised water scavenging gear and squeeze in behind panel

417, in the *Kvant 2* module. Wedged in between the *Elektron* unit and the urine reclamation system, and among a snare of wiring harnesses and tubing, one notices the constant buzz of electricity. The sound of the *Elektron* unit, electrolytically cracking water molecules into pure breathing oxygen and waste hydrogen. The electricity is delivered from batteries charged by our solar arrays. The water for *Elektron* is really evaporatively purified urine, produced by the adjacent urine reclamation system. The toilet, of course, would then be directly across the aisle. Pretty efficient, huh?

Only in microgravity could one consider access to this location. Body inverted behind the panel, plying in among the systems with my gear. Here I carefully pump out the grapefruit-size wobbling globes of water. They grow larger by the hour, as condensate accumulates on the ice-cold pipes supplying coolant to the power-hungry *Elektron* unit. A clumsy move sends water scattering in all directions. This chore generally serves as a morning shower. The "condensation" problem will be "designed out" of our next station. Next, I visit the four central air circulation intake filters and clear them of lost objects and debris of every kind.

Now, my favorite patient. The microgravity three-dimensional tissue cultures. Chamber 2, containing human immune system cells, has been running a tad cool. Chamber 4, growing human nerve tissue, is consuming glucose faster than planned and running on the acidic side. Microscopy of the kidney tissue is on today's schedule. It is important to observe every detail of the behavior of these cultures, as these are key preliminary studies for our tissue engineering program planned for the next space station....

On to the protein-crystal growth experiment. It is levitated and held in position by a set of electromagnets precisely controlled by a computer. In this way the ultrasensitive growing crystals are isolated from the small vibrations existing even in the spacecraft. Particularly when Anatoly is on the treadmill. In space, a "crystal" may be essentially a runny Jello that would collapse under its own weight in gravity. Or, it can be a solid material whose atoms will not sufficiently organize in the presence of gravity to even form a crystal. Here, absence of convection helps us crystallize these medically important proteins and allows analysis of their structure and function.

...Darn, that's what has been nagging at me. Later today I'm scheduled to review, on optical disc, their latest plan for next week's crystal growth studies. This time, using laser interferometry, we will study the crystal growth patterns on a size scale of one wavelength of laser light. Better get to the rest of the air filters. Maybe I can find that disc that I lost yesterday.

A quick look at the radiation detector data. High. Much higher than we have been seeing. Air pressure and air composition data look good. Pasha posts the communication pass times and updates the orbital trajectory navigation programs. He checks the spacecraft electrical system current draw versus solar array energy production and then we meet for coffee at the galley. Later Pasha is scheduled to change a coolant pump as preventative maintenance for the spacecraft's thermal control system.

Tolya...was overhauling the spacesuits after yesterday's spacewalk. This guy is always up early. Yesterday he changed a vacuum regenerable CO_2 absorption cartridge, in the *Vozdukh* air purification system, before breakfast. He scans the ship's master caution and warning panels. Reviews the system status displays. Then, satisfied with our gyroscopic attitude control system and conventional thruster engine status, Tolya does a double flip that would raise Olga Korbut's eyebrows, over the dinner table, and joins us with a big smile. I poke the recycled water delivery needle through the septum of the bag of rinseless soap and fill it with warm water. Tolya rehydrates a bag of white stuff with nuts that I haven't figured out the identity of yet. We quickly trade information and check in with Earth. They tell us there's been a solar flare. Nothing to worry about but better if we sleep in the areas better protected from radiation. So much for my move back to the airlock.

Inevitably, morning rounds generate a to-do list of maintenance that must be worked into our daily plan. Yesterday it was the air/fluid separators, which provide bubble-free water to the ion exchange purification columns. This is essential for recycling atmospheric condensate back into drinking water. The day before, a solar array wasn't tracking the sun

properly. After Monday's spacewalk, the primary airlock failed its leak check upon repressurization. The backup airlock, my bedroom, had to be used. It's too full of stuff now for me to move back into—even if the radiation level was normal.

During yesterday's spacewalk, the newly installed solar array failed to completely unfurl with the automatic computer sequence.

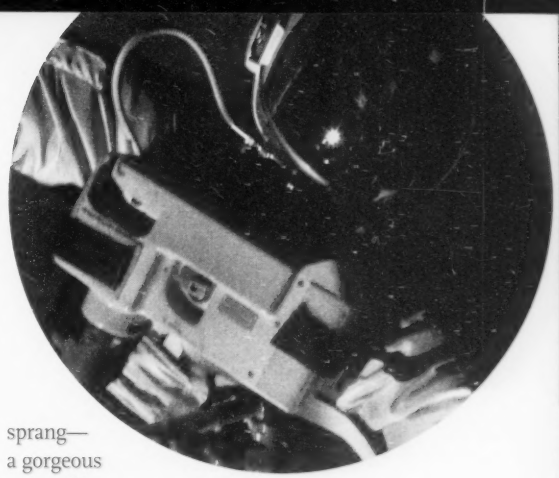
Always something.

Just like I remember my house on Earth. With each problem comes a new lesson, though. Each "failure" is really another glance into that crystal ball foretelling the "would-have-been" future of our joint space station....But the lab goes on running. We protect the lab. First, basic life support; second, the lab; then the creature comforts like hot water, or extra lighting, or movies, music....Time to go to work.

...The work days are long but there really isn't anywhere else much to go. Little things mean a lot up here. A few casual words on the radio, a token sent on the infrequent resupply ships, e-mail. We love the candy sent by the good folks at Moscow's famous "*Kracnie Octobrie*-Red October" candy factory—hint, hint. Sometimes, I just like to float back, cloud of macadamia nuts surrounding me, hovering bag of rehydrated grapefruit juice, and watch a video movie. Particularly scary ones about space.

Remember the look you got from your dad the first time you got to drive alone, or your airplane instructor at your first solo flight? That was Tolya (our commander) when he and Pasha shut the hatch to go outside for their spacewalk Monday. We all know I don't drive this thing so good, but the time had arrived to hand over the keys. The rolling of their eyes gave me the distinct feeling that they really didn't even want to be there to watch. Well, we got through it. I felt like the kid in *Home Alone* as I assumed Tolya's usual posture at the central command post, the cockpit. Or, was it Kirk's position? Dream and reality run so close here.

Tolya is a master spacewalker and yesterday was his fourteenth EVA. Pasha on his second. With their six-pound-per-square-inch pure oxygen pressurized gloved hands they transported and installed a massive fifty-foot solar array. We all work out, every day, so we will be able to even move the fingers of these pressurized gloves during a six- to eight-hour spacewalk. The hands wear out first. What a sight (and sound), two suited cosmonauts crawling around outside. Occasionally surprising me by looking in a window. ...The position of their little "one-person" spacecraft can be tracked by the clanking sounds through the ship's aluminum alloy hull. From their mobile jungle of cables, tethers, and metal boxes, sprang—well, almost sprang—a gorgeous new gallium arsenide solar panel. It kinda sprang halfway and stopped.



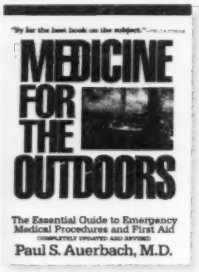
My job was issuing the computer commands to the new array's deployment mechanism, and something didn't work. Now we were "off nominal" and "out of the checklist," going fast, in Russian, and short of time left on the spacesuit carbon dioxide scrubbers. In coordination with the Russian mission control center...we improvised manual sequence procedures to command the solar array deployment—"Retract two steps—disable motion quick, it's jammed—try to re-extend by one step—what are the motor power indications? Is there a center-section deployed indication? We need to re-initialize the sequencer...."—as fast as my fingers could press buttons. Finally, I have an answer for that repeating question, "What has been your toughest moment so far in the mission?"

Then, as the sudden blackness of the Earth's shadow envelops the "walkers," helmet lamps blink on, and Tolya shouts, "*On dviegaet* (it's moving)." The team continued to work the array all the way out—to the fully deployed position, using this new manual sequencing mode, developed on the spot. It was a real thrill to be part of the team. Pash and Tolya hadn't even doffed their liquid cooling garments when we did a high five that sent us all into backwards cartwheels. We had more power. And power, along with atmosphere and water, is what is really important up here. The rest comes and goes. That's life in space and it sure has its moments.

Dave

Above: Gemini 4 (1965). "You look beautiful, Ed!" exults crewmate/photographer James McDivitt, as Edward White floats giddily over the Gulf of Mexico in the first-ever spacewalk.

Center: Ed White snapped over the Texas coastline by James McDivitt (Gemini 4). Both 70mm transparencies from *Full Moon* (see page 86).


"By far the best book on the subject."
MEDICINE FOR THE OUTDOORS
The Essential Guide to Emergency Medical Procedures and First Aid
Paul S. Auerbach, M.D.

Medicine for the Outdoors

The Essential Guide to Emergency Medical Procedures and First Aid

Paul S. Auerbach, M.D. 1999 (revised ed.); 499 pp. $22.50. Lyons Press.

If you can't have an experienced emergency physician with you when you're traveling off the beaten path, take this book. And read it first! This book replaces my previous recommendation of a wilderness/travel medical guidebook, Wilkerson's *Medicine for Mountaineering*.

The book is intended for use when a medical emergency occurs away from medical care. It includes general medical principles that should apply to all outdoor travel, and things to do before you go. I particularly like Auerbach's statement about carrying appropriate survival supplies: "Minimize the need for improvisation."

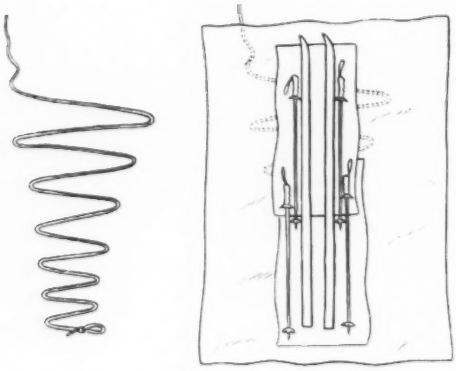
The first big section covers major medical problems, such as the approach to the unconscious patient; chest injury; bleeding; shock; head injury; allergic reaction; poisoning; emergency childbirth; and infectious diseases. Next come minor medical problems; then disorders related to specific environments, such as cold or heat injury and illness; altitude-related disorders; animal attacks; underwater diving accidents and near drowning. Last is a miscellaneous section, including administering oxygen; disinfecting water; motion sickness; first-aid kits; transport of injured victims; and ground-to-air distress signals. There are several useful appendices, including information on commonly used drugs and guidelines for prevention of disease transmitted by blood and other bodily fluids. And if a picture is worth a thousand words, the clear and appropriate illustrations double the word count.

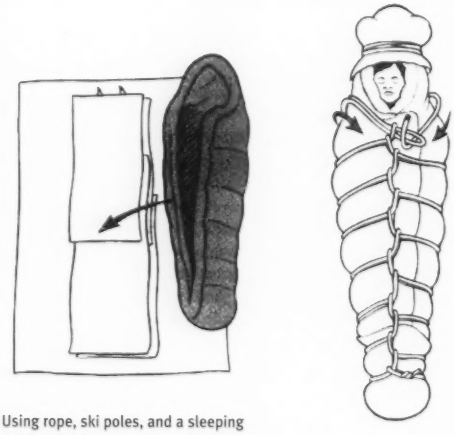
Paul Auerbach is a physician at Stanford University's Division of Emergency Medicine, a founder of the Wilderness Medical Society, and an advisor to the Divers Alert Network, the National Ski Patrol system, and the Institute for Preventative Sports Medicine. —Flash Gordon, M.D.

Life jacket brace to assist in the relocation of a dislocated humerus.

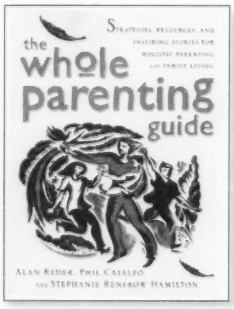
❝ *A tourniquet is indicated only in a life-threatening situation and is best applied by an experienced person.* Only in the case of torrential bleeding is a tourniquet more advantageous than continuous pressure. The decision to apply a tourniquet is one in which a limb is sacrificed to save a life.

❝ In general, it is unwise to manipulate an injured limb. If the extremity is deformed, but the circulation is intact (normal pulses, sensation, temperature, and color), do not attempt to straighten it; instead, splint it in the position in which you found it ("splint 'em as they lie"). On the other hand, if the circulation to an extremity is obviously absent (the extremity is numb, cold, and blue or pale), if the victim is in extreme discomfort, or if gross deformity prevents moving the victim out of a dangerous situation or prevents the application of a splint, then an attempt to restore the part to a normal position is justified....If there is no deformity, splint the injured body part in the "position of function" (the position it would assume if it were at rest).





Using rope, ski poles, and a sleeping bag or blankets to make a mummy litter.



The Whole Parenting Guide

Strategies, Resources, and Inspiring Stories for Holistic Parenting and Family Living

Alan Reder, Phil Catalfo, and Stephanie Renfrow Hamilton. 1999; 430 pp. $20. Broadway Books.

The authors of *The Whole Parenting Guide* realize that folks who have a progressive bent before the kids come along don't necessarily check these values at the delivery-room door. This cradle-to-college primer offers an expansive overview of "alternative" parenting: healthy birthing, progressive family values, holistic medicine and nutrition, positive learning and creativity, family environmentalism, social responsibility, and spirituality. It serves up practical tips for applying these concepts in your own home, real-life stories from "whole parents," and extensive resources for further study.

The *Guide* tackles its subject with wit, wisdom, and, most importantly, balance. The authors, all veteran parents and journalists, know that there is no one "right" way to raise children and that some holistic prac-

4 Steps to Financial Security for Lesbian and Gay Couples

Expert Advice for Reducing Your Tax Burden, Increasing Your Wealth, and Protecting Each Other

Harold L. Lustig. 1999; 296 pp. $14. Fawcett Books.

I recommend this book highly. As a financial consultant, I'm adding it to my library, where it will be an excellent resource for my gay and lesbian clients. Chapter 1 ("Twenty-one Myths That Can Make You Poor"), for instance, is right on target, and is followed by excellent chapters on estate, insurance, investment, and retirement problems with which a gay or lesbian couple must contend. The book's sections on use of insurance and planning for death, and its step-by-step instructions for each planning phase, are exceedingly useful. Its overall advice would be beneficial for anyone.
—James E. Runyeon

"Myth #9: My partner has domestic partner benefits at work. I will be protected by COBRA if his employment is terminated.

This is incorrect. Spouses in legally recognized marriages are protected, but since federal law does not recognize your relationship, you are not protected in the same way. Should your partner's employment be terminated, you will have no coverage unless the insurance carrier has special provisions.

"Myth #21: There is little or no financial difference when a partner, rather than a married spouse, dies.

Actually, there is a very big difference. This is where the pedal hits the metal, where political disenfranchisement hits the pocketbook. Retirement plan payments may continue if your partner has already retired, but everything can be lost if death occurs before retirement. (For married couples, payments continue.) Social Security doesn't protect the surviving partner. Joint property can be taxed differently for you than for married couples. You need to have documents proving how much each partner actually contributed.

On the other hand, you have a major advantage over straight couples who wrongly assume there is no urgency about doing financial and estate planning: Because you don't have the luxury of making false estate assumptions, you have an opportunity to be better prepared for the future.

"When Ruthie passed away in 1992, she left Louise $80,000 in her 401(k). Louise thought she could transfer the proceeds from the account into an IRA in her own name, let the money grow, and start taking out an income when she retired. No big deal. Certainly made sense to her and her friends. Was she ever wrong!

To say that Louise was surprised when she had to fork over $24,800 out of her own pocket to the IRS for taxes on Ruthie's 401(k) would be an understatement. When she learned later that her sister did not have to pay any extra taxes on her husband's retirement plan when he died, she was outraged.

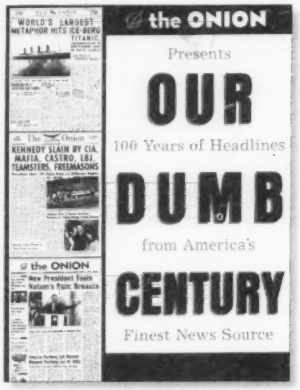
tices don't stand up to critical scrutiny. Among reality checks: The authors admit that even parents who are wary of the mass media need to use television as a babysitter from time to time, and caution that parents who allow nothing but tofu and tabbouleh to cross their kids' lips may soon find them sneaking off to blow their allowance at Burger King.

A few quibbles. The *Guide* may not be alternative enough for many readers. For instance, the authors come down firmly in the mainstream on such hot-button issues as childhood vaccinations (they do give voice to the anti-vaccination arguments other parenting tomes wouldn't touch). And since much of the advice isn't broken down by age, parents of young children have to plow through reams of information aimed at mothers and fathers of older kids (and vice versa). Even so, the book is welcome. Dozens of parenting guides address the day-to-day practicalities of raising children. Here, at last, is one that speaks to the soul as well. —Leah Hennen

"If "managing" war play and limiting violent video games still doesn't go far enough for your taste, we understand entirely. Watching your little innocents gleefully lay waste to armies of friends is not a comforting sight. But as parent Susan Marchionna points out, you may not have another option: "We didn't have too many rules about guns, because it became apparent very early on that a kid was always carrying a gun in his index finger—in fact, two of them. And sticks work just fine as guns too"....

The grumbling about kids in the current era sounds especially cranky because it arises from yet another fiercely contested battleground in the culture wars. According to one side, permissive parenting and moral relativism is the problem and strict obedience, rigid rules, religious piety, and unquestioning acceptance of "traditional family values" is the answer. According to the other side, the family values camp is pining for a time that never really was. Besides, these parents say, such militaristic ideas of good parenting will create mindless robots unable to handle the moral complexities of modern life and citizenship.

Which side has the goods on how to raise decent kids? Ultimately, neither. Raising moral kids may not be easier than any other aspect of parenting, but it isn't the mystery the culture war makes it seem, either.



Our Dumb Century

The Onion Presents 100 Years of Headlines from America's Finest News Source

Scott Dikkers, ed. 1999; 164 pp. $15. Three Rivers Press.

***Our Dumb Century*—from the publishers of that First Amendment bowsprit, *The Onion*—recapitulates one hundred years of confabulatory news headlines. Here's that whiff of authenticity—or something—a reader craves.**

Call it the marginal, the prurient, and the vulgarized. Started by two University of Wisconsin undergrads eleven years ago, *The Onion* graduated from "sophomoric college-humor publication" (editor Dikkers's words) to the bastion of newspaper parody it represents today (www.theonion.com):

"Ralph Nader Killed in Pinto Test Drive"
"President Calls for Calm Following Nipple Sightings on Farrah Fawcett Poster"
"Jacqueline Kennedy Catches Husband's Brains with Grace, Aplomb"

Is this genius?

"Jim Henson Stuffed, Given Googly Eyeballs, Placed in Smithsonian"

I dunno. *Punch*, it's not. On the other hand,

"Author Ernest Hemingway Grits Teeth, Beds Nurse, Fights in War, Sits at Bar, Remembers Nurse"

Fun.

A compendium of classics...and a matter of taste—and thresholds. —NP

"Zapruder Family Wowed at Home Movie Screening: The family of Abraham Zapruder of Dallas offered high praise for his most recent 8mm home movie, screened in the family den Friday.

Wife Margaret and children Sally, Jimmy and Sue-Anne...reported being wowed by Zapruder's "spectacular, one-of-a-kind" footage of the President of the United States getting his head shot off. "It was super neat!" said Jimmy, 11.

"Brother Unable to Spare Dime

Hartford, Conn., Feb. 3. —...Timothy Lawson, 39, a Hartford-area pedestrian, was unable to spare a dime on the corner of South Orchard and 8th Streets Wednesday.

Charles Kriefski, an out-of-work Hartford resident, said in the report that he looked at Lawson and made a polite request for a dime at approximately 4:15 P.M., yet no dime exchanged hands at any point during the interaction.

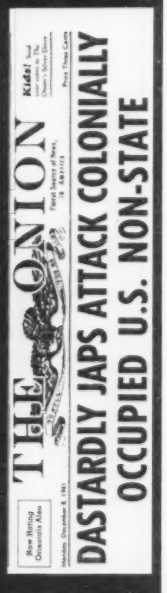
Lawson reportedly walked past Kriefski and shook his head quickly without looking up. According to Kriefski, such a motion is an indication that a dime cannot be spared.

...According to the report, Kriefski's addressing Lawson as "brother," an effort to build an instant rapport via their shared humanity, was ineffective, as Lawson was not lured into a temporary and superficially familiar relationship with Kriefski that could have resulted in the exchange of a dime.

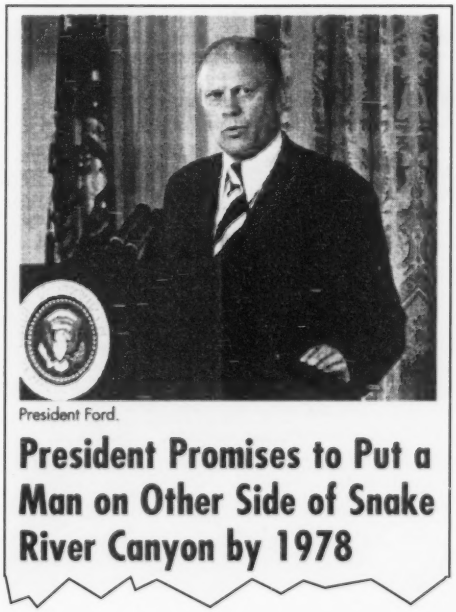
" Charleston State Prison, Mass., Aug. 23. —Nicola Sacco and Bartolomeo Vanzetti died in the electric chair today, having been found guilty on two counts of murder and larceny, and one count each of being greasy, violence-prone wops.

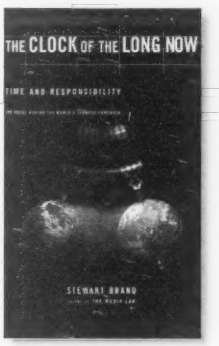
...Even with the specter of death surrounding them, the unrepentant pair refused to renounce their ethnic ways, and met their demise utterly and completely Italian.

" **INSIDE**: Truman explains to Americans where North Korea is and why it must be destroyed; "Why, that sounds fine," say Mr. and Mrs. America.



Ladies, Negroes Momentarily Useful
Temporary Seattle steel worker Evelyn McGraw gives the rivets on a B-17 Flying Fortress fuselage the "feminine touch."





The Clock of the Long Now

Time and Responsibility

Stewart Brand. 1999; 190 pp. $22. Basic Books.

Stewart has written an important book. He asks: "How do we make long-term thinking automatic and common instead of difficult and rare? How do we make the taking of long-term responsibility inevitable?" He has in mind 10,000 years—a future period equal to our lives on Earth since the last glaciation.

Always the superb cultural navigator, Stewart spots, points to, and aligns myriad paths in this time-terrain. His two tools are "notional" (thought) experiments and a specific project to build a shrine to time (a mechanical clock that will operate for 10,000 years). Stewart envisions an *intentional* time-shrine that would incessantly bring people back to the long view—a clock interacting with us for many generations, harmonic with slower biospheric and cultural continuities, honing and sanctifying our wisdom.

We once talked about the time-shrine. It might become one stopping place on tourist itineraries. Tourism might just be an embryological predecessor to a new, post-modern sacredness; tourism might turn to pilgrimage as in older cultures like India and Jerusalem. To natural ancient wonders (Yellowstone, Grand Canyon), and to the future speedo-techno-wonders (Disneyland? the Space Museum?), the Long Now Foundation would add a VERY SLOW-PACED clock wonder, a wonder dedicated to responsibility.

Stewart's writing is a pleasure. He has taken his exemplary condensed, spare, and clean "book review" prose, so familiar to readers of *Whole Earth Catalog*s, and extended it to twenty-five essays averaging about seven pages each. One essay takes the form of a talk; another a letter. Craft is everywhere, gracious and at ease.

In a unique essay design, his friends and colleagues (Esther Dyson, Brian Eno, Danny Hillis, Kevin Kelly, to name a few) appear momentarily in one essay, then another, giving the book a town-hall or powwow musicality—almost a short-novel texture of many voices.

Personally, I am unsure how considering 10,000 years (rather than twenty or 2,000) engenders more responsibility here and now. I do remain hopeful that, after reading this book, many Holocene geologists and Silicon Valley software engineers might join, for instance, the task of saving California's last redwoods from Maxxam Corporation. After all, did Microsoft's Paul Allen have to think 10,000 years before purchasing Loomis State Forest? If Bill Gates thinks the Long Now, might he too decide to donate one day's income and stop the Headwaters controversy, preserving thousands of years of information—neatly stored in tree rings and many species' DNA—for thousands of future years for millions of people? A Microsoft time-shrine to sequoias? Is this a maniacal naturalist's tragic optimism?

Stewart coined the "Big Here," giving out free images of the Earth taken from outer space. He now offers what no other book or tool kit has for decades: a gift of liberty to think and act with more clarity, fun, and imagination about the Long Us. —PW

"Fiction has to be plausible; reality doesn't.

"The Clock/Library aims for the mythic depth to become, as Brian Eno puts it, "one of those system-level ideas which sets in motion all sorts of behavior without ever having to be referred to directly again. This is what dominant myths do: they make some sorts of behavior ring with recognition and familiarity and value and a sense of goodness, and thus lay deep templates for social cohesion about what would otherwise be very hard-to-discuss topics."

"...It is not so much a conversion experience as a deep pause, like coming upon the Grand Canyon by surprise, where you simply want to sit and watch for a while and let your life adjust to two million years visible in one glance.

"Who tends the Clock and the Library for the ongoing millennia? The clearest model of how to run a charismatic site is the central Shinto complex in Japan known as the Ise Shrine.

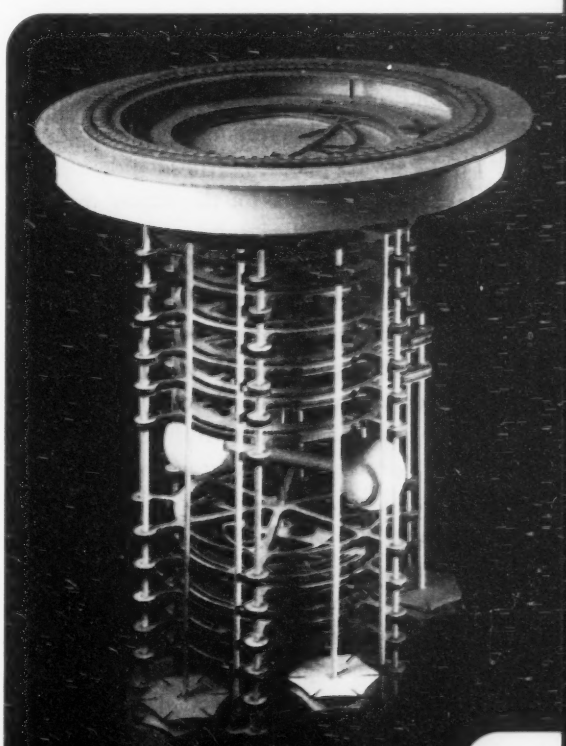
...Every twenty years for well over a thousand years the all-wood shrine has been totally reconstructed—a perfect replica built next to the previous building. The sixty-first rebuilding took place in 1993. Ise is the world's greatest monument to continuity—an unbroken lineage of structure, records, and tradition on a humid, earthquake-prone, volcanic island. Its ancient rites are alive and meaningful. Materials dismantled from the replaced building are recycled to other shrines throughout Japan.

"Suppose we wanted to improve the quality of decisions that have long-term consequences. What would make decision makers feel accountable to posterity as well as to their present constituents? What would shift the terms of debate from the immediate consequences to the delayed consequences, where the real impact is?...

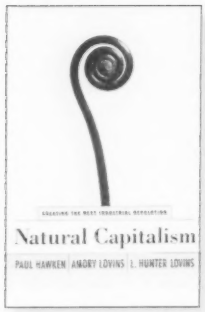
One side of such a debate could file (for a fee) its arguments, facts, media reports, major players, and predictions with the Library's Responsibility Record, along with desired times in the future for the records to "wake up" for review. The Library would then of course contact the opposition to see if they would like to do the same....

Years later, at the wake-up times, those living with the consequences of the decision will be able to see what both sides registered...whether the terms of the original debate had anything whatever to do with what actually happened. This is where the real payoff lies....The Library can accumulate detailed records of countless sequences of debate-decision-consequence....A well-managed Responsibility Record would be both trove and warning.

"The core fallacy of futurismo is: Desire always misreads fate.



Below: The first version of the prototype Millennium Clock. It will be the slowest computer ever invented.



NATURAL CAPITALISM
Creating the Next Industrial Revolution

Paul Hawken, Amory Lovins, and L. Hunter Lovins. 1999; 288 pp. $16.95. Little, Brown and Company.

The concept and strategies of *Natural Capitalism* hold immense promise for one of the true challenges of our times: bringing our way of living in industrial societies into harmony with the natural systems of which we are but one small part.

Natural Capitalism holds out the promise for businesses to "do well by doing good." It presents an elegant, intuitive systems framework to guide enterprises in pursuing the elusive aim of "sustainability." The book centers on four "basic shifts in business practices":

Shift #1: Radical Resource Productivity.

Shift #2: Ecological Redesign (closed-loop production models).

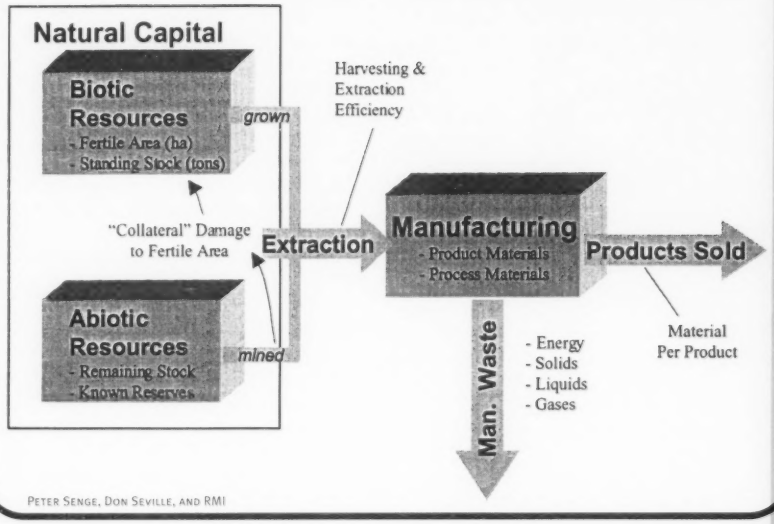
Shift #3: Service and Flow Economy (solutions-based business models).

Shift #4: Investing in Natural Capital.

I fear that this great strength of *Natural Capitalism* will also prove its limitation. Managers are used to piecemeal, formulaic solutions to complex problems. The key to natural capitalism as a foundation for building the post-industrial economy is that it is imperative to pursue *all four basic shifts.*

In particular, many business enterprises today are pursuing the first of these shifts, resource productivity or, as it is commonly called, "eco-efficiency" (getting more output per natural resource input). *Natural Capitalism* is full of impressive examples of the business potential of this kind of radical resource productivity, and I suspect many business leaders not currently pursuing eco-efficiency will begin, on reading this book, to see its potential. The basic case is compelling: using more resources than required is tantamount to having higher costs than needed. Waste equals cost. Lowering waste can lower costs and improve profitability. Yet it is easy to see that, for the natural system as a whole, it is possible to increase resource productivity but do more *harm* to nature.

To see this, consider the stock-and-flow diagram above. It shows how the industrial production system nests within the larger natural system. Starting with "Natural Capital," we see that all industrial products are created using resources extracted from nature, either biotic (i.e., living) or abiotic (non-living). This flow of timber, grain, minerals, land, energy, wood, water, and so on is processed through the many stages ("Extraction" and "Manufacturing") to eventually become the products sold to consumers. But actually only a tiny fraction of extracted material becomes products sold—less than 6 percent (by weight) when the entire industrial system is taken into account. The other 94 percent becomes waste—the primary output of the present industrial system! Eco-efficiency not only leads to gains in production, it increases the ratio of production to extraction, reducing the proportion of waste generated. Potentially, society wins and nature wins.



PETER SENGE, DON SEVILLE, AND RMI

But this is only one facet of a larger system. Products sold become goods in use, all "the stuff" owned by consumers and producers, from washing machines and PCs to airplanes and machine tools. And, of course, this stuff must go somewhere once its productive lifetime is over. Typically, it too becomes waste. Moreover, other types of waste are generated from the products in use, such as emissions from automobiles and industrial smokestacks. Waste from all three of these sources—production, use, and eventual discard of goods—accumulates in nature, some for a very long time. This accumulated waste is not benign—much of it interacts with nature's own regenerative processes, thereby reducing the rate at which the stocks of some natural resources replenish themselves.

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In summary, my fear is that businesses will lock onto resource productivity—eco-efficiency—alone, and see it as sufficient basis for environmental responsibility. Of the four tenets of *Natural Capitalism* it is the least threatening to the status quo. What business would not want to eliminate input costs, and thereby increase profit? But, what will then happen with the increased profits? Will they be invested in pursuing the other three basic shifts, as Hawken and the

Lovinses hope, or will they be invested in simply creating more growth of traditional products and processes?

Growing more rapidly at less resource intensity is not even necessarily a step forward in total resource extraction: if the rate of growth swamps the rate of eco-efficiencies (especially on a global scale), extraction and wastes can actually increase. Nature does not care about eco-efficiencies, if it ends up that we extract and waste still more. And it could.

These matters, all discussed in *Natural Capitalism*, couldn't be more timely. I believe there is a real awakening among business leaders around the world today toward a genuine desire for greater stewardship of our natural resources. And, because this represents a deep set of societal needs, there are real opportunities to build healthy businesses by meeting those needs. In other words, the free market need not be the enemy of nature. But aligning free-market forces with nature's realities will require a systemic, not a fragmented, understanding.

If we truly seek new ways of living that can assure the vitality of our great grandchildren, we must attend to the system as a whole, and that means the synergies among the four basic shifts—the real message of *Natural Capitalism*.

—Peter M. Senge, MIT and the Society for Organizational Learning

"While living systems are the source of such desired materials as wood, fish, or food, of utmost importance are the *services* they offer, services that are far more critical to human prosperity than are nonrenewable resources. A forest provides not only the resource of wood but also the services of water storage and flood management. A healthy environment automatically supplies not only clean air and water, rainfall, ocean productivity, fertile soil, and watershed resilience but also such less-appreciated functions as waste processing (both natural and industrial), buffering against extremes of weather, and regeneration of the atmosphere.

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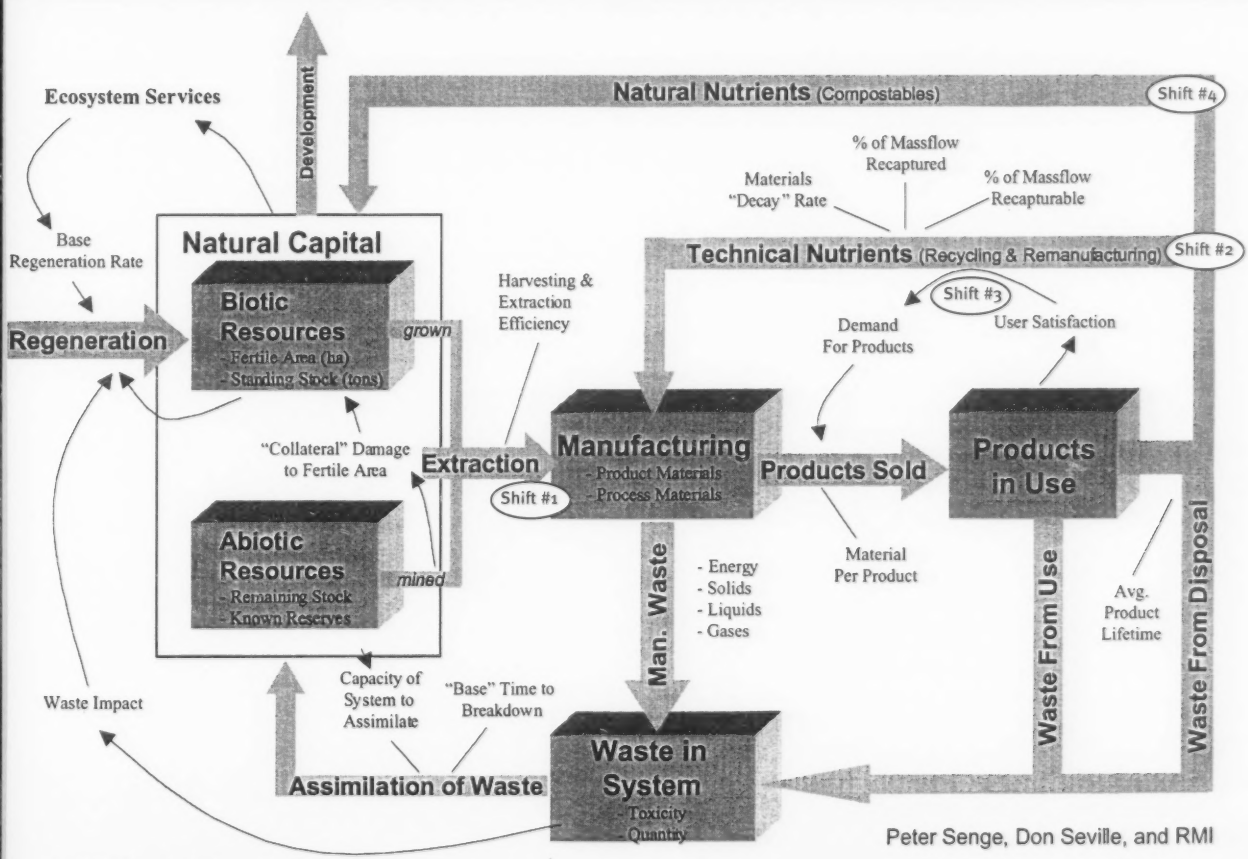
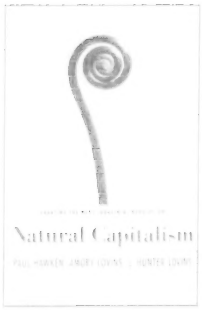
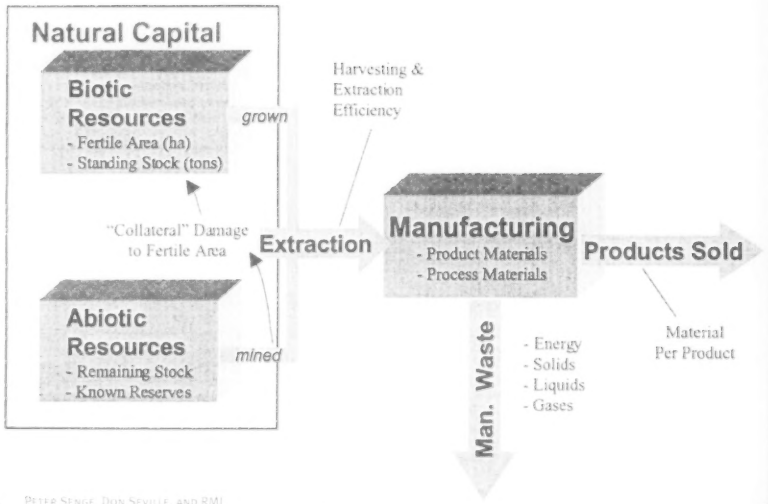


Peter Senge, Don Seville, and RMI



NATURAL CAPITALISM
Creating the Next Industrial Revolution
Paul Hawken, Amory Lovins, and L. Hunter Lovins. 1999; 288 pp. $16.95. Little, Brown and Company.



PETER SENGE, DON SEVILLE, AND RMI

The concept and strategies of *Natural Capitalism* hold immense promise for one of the true challenges of our times: bringing our way of living in industrial societies into harmony with the natural systems of which we are but one small part.

Natural Capitalism holds out the promise for businesses to "do well by doing good." It presents an elegant, intuitive systems framework to guide enterprises in pursuing the elusive aim of "sustainability." The book centers on four "basic shifts in business practices":

Shift #1: Radical Resource Productivity.

Shift #2: Ecological Redesign (closed-loop production models).

Shift #3: Service and Flow Economy (solutions-based business models).

Shift #4: Investing in Natural Capital.

I fear that this great strength of *Natural Capitalism* will also prove its limitation. Managers are used to piecemeal, formulaic solutions to complex problems. The key to natural capitalism as a foundation for building the post-industrial economy is that it is imperative to pursue *all four basic shifts*.

In particular, many business enterprises today are pursuing the first of these shifts, resource productivity or, as it is commonly called, "eco-efficiency" (getting more output per natural resource input). *Natural Capitalism* is full of impressive examples of the business potential of this kind of radical resource productivity, and I suspect many business leaders not currently pursuing eco-efficiency will begin, on reading this book, to see its potential. The basic case is compelling: using more resources than required is tantamount to having higher costs than needed. Waste equals cost. Lowering waste can lower costs and improve profitability. Yet it is easy to see that, for the natural system as a whole, it is possible to increase resource productivity but do more *harm* to nature.

To see this, consider the stock-and-flow diagram above. It shows how the industrial production system nests within the larger natural system. Starting with "Natural Capital," we see that all industrial products are created using resources extracted from nature, either biotic (i.e., living) or abiotic (non-living). This flow of timber, grain, minerals, land, energy, wood, water, and so on is processed through the many stages ("Extraction" and "Manufacturing") to eventually become the products sold to consumers. But actually only a tiny fraction of extracted material becomes products sold—less than 6 percent (by weight) when the entire industrial system is taken into account. The other 94 percent becomes waste—the primary output of the present industrial system! Eco-efficiency not only leads to gains in production, it increases the ratio of production to extraction, reducing the proportion of waste generated. Potentially, society wins and nature wins.

But this is only one facet of a larger system. Products sold become goods in use, all "the stuff" owned by consumers and producers, from washing machines and PCs to airplanes and machine tools. And, of course, this stuff must go somewhere once its productive lifetime is over. Typically, it too becomes waste. Moreover, other types of waste are generated from the products in use, such as emissions from automobiles and industrial smokestacks. Waste from all three of these sources—production, use, and eventual discard of goods—accumulates in nature, some for a very long time. This accumulated waste is not benign—much of it interacts with nature's own regenerative processes, thereby reducing the rate at which the stocks of some natural resources replenish themselves.

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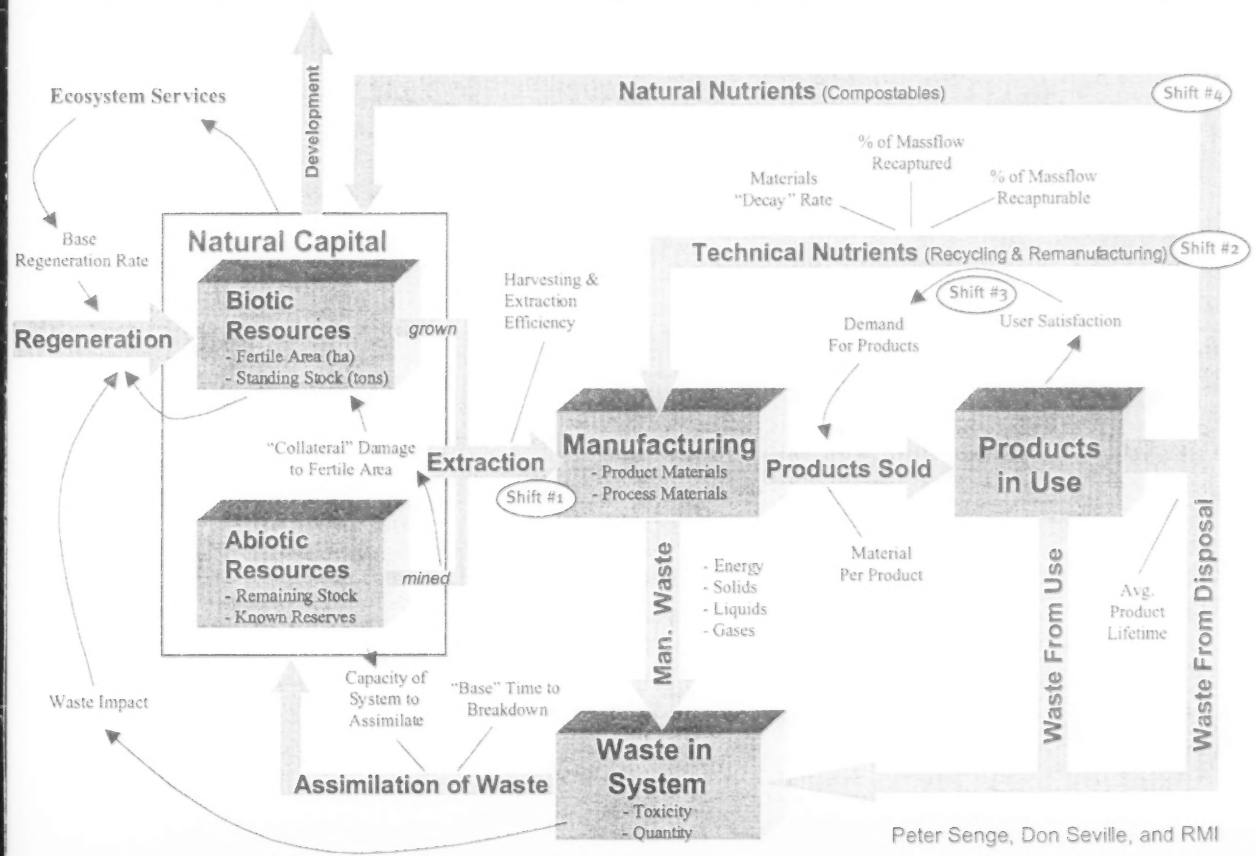

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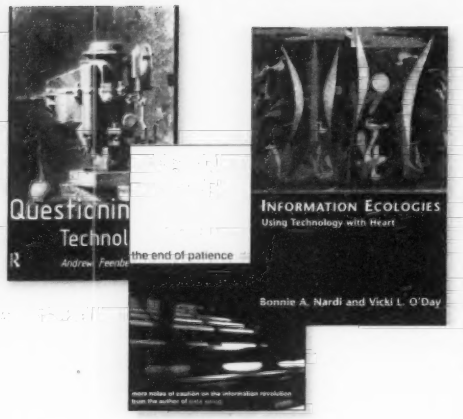


Information Ecologies
Using Technology with Heart

Bonnie A. Nardi and Vicki L. O'Day. 1999; 231 pp. $27.50. MIT Press.

The End of Patience
Cautionary Notes on the Information Revolution

David Shenk. 1999; 157 pp. $19.95. Indiana University Press.

Questioning Technology

Andrew Feenberg. 1999; 241 pp. $24.99. Routledge.

Until recently, you had to go back to Jerry Mander's *In The Absence of the Sacred* (1992) and Langdon Winner's *Autonomous Technology* (1977), and further back to Lewis Mumford's *The Myth of the Machine* (1966), to find technology criticism that looked at the big picture. Bonnie Nardi and Vicki O'Day, David Shenk, and Andrew Feenberg are recent technology critics of very different kinds who seem to appreciate and understand the phenomenon they are critiquing.

Nardi and O'Day (*Information Ecologies*) attempt to reframe our civilization's conversation about tools from the perspective of "critical friends of technology." As researchers at Xerox Palo Alto Research Center and Apple Computer, they built a virtual community, called Pueblo, for students and teachers in one of the poorest schools in America; they use that experience as one of the book's concrete examples. Acknowledging the power of tool, text, and medium-metaphors for talking about technology, they propose a more systemic metaphor: *technological ecologies*. Theirs is the most concrete of these books, based on their direct experience with online educationai communities, special libraries for high-tech companies, new information media in surgical theaters, the staff practices of a software development company, and technology in other settings.

David Shenk (*The End of Patience*) is a popular commentator, informed skeptic, and admitted technology enthusiast, whose short pieces collected here have been broadcast on NPR and published in *Harper's*, the *New York Times*, and *Wired*. His short takes aren't frontal assaults, but occasions to pause and think about the ways Photoshop and cellphones, e-mail and corporate funding of fundamental research, alter our lives.

Andrew Feenberg (*Questioning Technology*) is the hardest to read. He is a philosopher of technology and an advocate of a specific point of view, the post-Communist "Marxian" analysis sometimes known as critical theory. Feenberg focuses on the bonds that mesh technologies, economies, and our daily lives into an indivisible and emphatically political system. Like Langdon Winner, Feenberg sees technologies as political regimes that both shape and are shaped by the way people use and think about tools.

None of these books provides answers. They do provide ways to think about the technopolis we both create and inhabit—and how we might do so more consciously.
—Howard Rheingold

> "...people often talk about a technology as a *tool*. Because the purpose of tools is to accomplish something useful, talking about technology as a tool prepares us to think about the particular tasks people can accomplish with technology. The tool metaphor suggests that a person is in control of a technology she uses, because tools are objects we control....
>
> But it is important to recognize that all metaphors channel and limit our thinking, as well as bring in useful associations from other contexts. That is the purpose of a metaphor, after all—to steer us to think about the topic this way rather than some other way. Because we want to challenge traditional assumptions about how technology should be developed and used, we must also recognize and challenge some of the familiar metaphors that are commonly used to simplify and explain technology development.
> —Information Ecologies

> "We define an information ecology to be a system of people, practices, values, and technologies in a particular local environment. In information ecologies, the spotlight is not on technology, but on human activities that are served by technology.
>
> A library is an information ecology. It is a place with books, magazines, tapes, and films, and librarians who can help you find and use them. A library may have computers, as well as story time for two-year-olds and after-school study halls for teens. In a library, access to information for all clients of the library is a core value. This value shapes the policies around which the library is organized, including those relating to technology. A library is a place where people and technology come together in congenial relations, guided by the values of the library.
>
> A hospital intensive care unit is an information ecology. It has an impressive collection of people and technologies, all focused on the activity of treating critically ill patients. Human experts (nurses, physicians, therapists, ethicists) and machines (monitors, probes, and the many other devices in the ICU) all have roles to play in ensuring smooth, round-the-clock care. Though this is a setting with an obvious reliance on advanced technologies, it is clear that human expertise, judgement, empathy, cooperation,

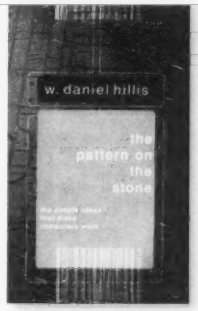
Right: Wicked technology. In Fritz Lang's *Metropolis* (1927), the inventor Rotwang fabricates a robot demagogue. Taking the form of the film's heroine, Maria, the robot is sent below ground to incite chaos among the worker-slaves. From *Information Ecologies*.

and values are central in making the system work.
—Information Ecologies

❝ Unfortunately, the cost of economic success may often be the integrity of the science itself. What are we to make of a recent study published in [*The Journal of the American Medical Association*] suggesting that an astounding 43 percent of women and 31 percent of men suffer from "sexual dysfunction"—once we also discover that two of the study's authors served as paid consultants to Pfizer? (The relationships were not disclosed in *JAMA*)....

Such subtle and not-so-subtle perversions of science would be very difficult to detect but would have very real economic and health implications for American consumers. Adverse side effects might not be adequately reported; drugs and devices with head starts would maintain artificial leads—and premium prices. Scientists wouldn't always pursue drugs and tests that lack obvious short-term markets. Ultimately, private science would answer not to the public good, but to the same pressures that drive stocks up and down. —The End of Patience

❝ The same kind of ignorance that bound men to the gold standard for centuries maintains the illusion that technology is an alien force intruding on our social life from a coldly rational beyond. The forces of the market were believed to transcend the will of peoples and nations. The economy was treated as a quasi-natural system with laws as rigid as the movements of the planets. The social nature of exchange had to be discovered against tremendous ideological resistance. Today it seems absurd that modern societies renounced control of their own economic life to a second nature they had themselves created. Yet where technology is concerned we remain in willful submission to a second nature just as contingent on human action as the economy. Liberation from technological fetishism will follow the course of liberation from economic fetishism. The same story will someday be told about machines that we tell today about markets.
—Questioning Technology



The Pattern on the Stone
The Simple Ideas that Make Computers Work

W. Daniel Hillis; 1998; 164 pages. $21. Basic Books/Perseus Books.

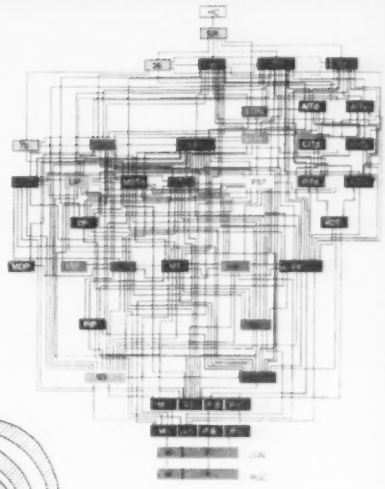
Computers so dominate our lives that we get lost in the details of one version of software after another, one generation of computers after another, and the current tangle of features, bugs, applications, and standards. The future of all that is appalling to contemplate. What a relief, then, to have Danny Hillis stroll with us through the basics, pointing out the simple things that continue to pertain decade after decade at the heart of these ambitious machines. When (if!) quantum computers come with their many-thousand-fold new capabilities, the same basics will apply. Knowing them makes the revolutions more manageable.

Computer basics are so simple, subtle, and potent that they elude even many professionals. Ingenious inventions themselves, they are powerful tools of invention on a par with language and mathematics. Hillis is the devisor and developer of massive parallel processing, which runs the current generation of supercomputers and lately employs the Net for distributed supercomputing in modest machines. He writes with authority and clarity both about the basics (he once made a working computer of Tinker Toys) and about what is coming as computers learn to generate capabilities the equal of ours, and beyond. —Stewart Brand (courtesy Global Business Network)

❝ In a sense, communication and storage are just two aspects of the same thing: communication sends a message from one place to another; storage "sends" a message from one time to another.

❝ Programmed computers, including their software, are by far the most complex systems ever designed by human beings. The number of interacting components in a computer is orders of magnitude larger than the number of components in the most complex airplane. Modern engineering methods are not really up to designing objects of such complexity.

❝ Most scientists would be surprised if quantum mechanics succeeds in providing a kind of computer more powerful than a Turing machine, but science



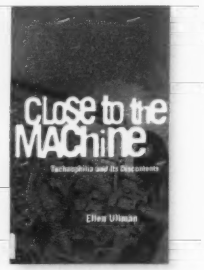
Right: The circuit diagram of the visual cortex of a macaque monkey appears as neatly wired as a computer, but doesn't account for non-hierarchical, bidirectional neural con-

Left: A perceptron, a simple neural network that can learn to recognize patterns, requires more than the sum of local parts to discern the whole; it cannot tell if this spiral is connected.

makes progress through a series of surprises. If you're hoping to be surprised by a new sort of computer, quantum mechanics is a good area to keep an eye on.

❝ Here I must pause to mention the *bit*. The smallest "difference that makes a difference" (to use Bateson's phrase again) is a difference that splits all signals into two distinct classes. In the tic-tac-toe machine, the two classes are "current flowing" and "no current flowing." By convention, we call these two possible classes 1 and 0. These are just names; we could as easily call them **True** or **False**, or **Alice** and **Bob**. Even the choice of which class is called 0 and which is called 1 is arbitrary. A signal that can carry one of the two different messages (like 1 or 0) is called a *binary* signal or a *bit*.

❝ Unlike most books on computers—which are either about how to use them or about the technology out of which they're built (ROM, RAM, disk drives, and so on)—this is a book about *ideas*. It explains, or at least introduces, most of the important ideas in the field of computer science, including Boolean logic, finite-state machines, programming languages, compilers and interpreters, Turing universality, information theory, algorithms and algorithmic complexity, heuristics, uncomputable functions, parallel computing, quantum computing, neural networks, machine learning, and self-organizing systems.



Close to the Machine

Technophilia and Its Discontents

Ellen Ullman. 1997; 189 pp. $12.95. City Lights.

Like an adult entering a room of noisy, giddy children, Ullman brings the humor, perspective, and responsibility of a grownup to the largely juvenile world of passion for high-tech. That passion is remaking everyone's world, so her insight is priceless.

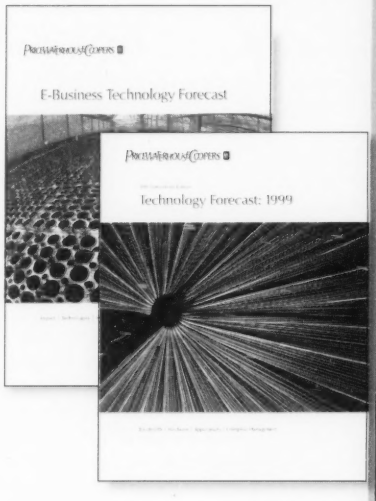
This is a textbook of how to live on the cruel edge of Schumpeter's "creative destruction." In her career as software engineer, begun in 1978, Ullman has had to teach herself "six higher-level programming languages, three assemblers, two data-retrieval languages, eight job-processing languages, seventeen scripting languages, ten types of macros, two object-definition languages, sixty-eight programming library interfaces, five varieties of networks, and eight operating environments." That's the rate of change in her business. That's the rate of change her business is bringing to all of us.

Ullman has a life, and it's in the book (a male programmer might have left that out). She was a Communist once. She has an affair with a younger programmer, warmly observant of his brittle oddness and his political theories. Migrating uncertainly from job to job, she honors confusion in herself, in life, like no writer I've ever read. A programmer's life is the same tragicomedy as all of us have, but sped up ten to a hundred times. It makes a new kind of hero, and heroine, in the world. She wouldn't say that, but her readers might. —SB

> It has occurred to me that if people really knew how software got written, I'm not sure they'd give their money to a bank or get on an airplane ever again.

> I've managed to stay in a perpetual state of learning only by maintaining what I think of as a posture of ignorant humility. This humility is as mandatory as arrogance....Bow your head, let go of the idea that you know anything, and politely ask of this new machine, "How do you wish to be operated?"...Loyalty to one system is career-death.

> The preciousness of an old system is axiomatic. The longer the system has been running, the greater the number of progammers who have worked on it, the less any one person understands it. As years pass and untold numbers of programmers and analysts come and go, the system takes on a life of its own....We no longer control it. We have two choices: respect it or kill it.



Technology Forecast 1999

PricewaterhouseCoopers Technology Centre. 1998; 817 pp. or electronic format. $450. PricewaterhouseCoopers. 800/654-3387, 314/997-2540, technology.forecast.editors@us.pwcglobal.com, www.pwc-tech-forecast.com.

For detailed commercial analysis of the present, good for about a year, nothing surpasses the *Technology Forecast 1999* from PricewaterhouseCoopers. Highly technical, 817 pages deep, this survey is a prime reference for anyone in the infotech industry. It covers everything from an ancestry chart to the half-dozen current flavors of UNIX to the variations in "tele-density" (phone lines per 100 people; tops is Monaco) around the world. —SB

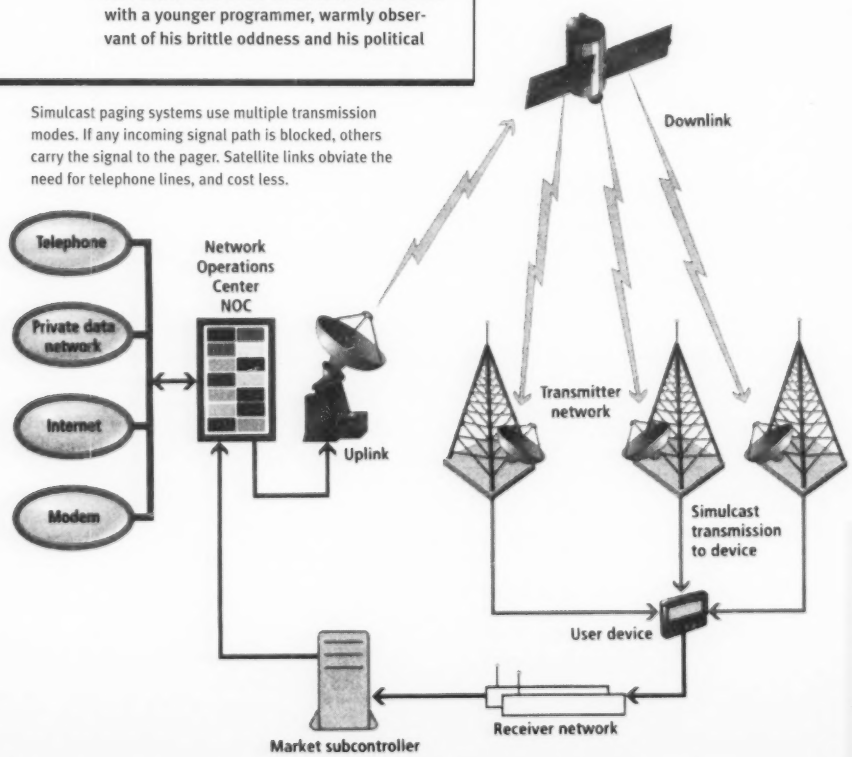
Profitable information yearns to be exclusive. At $450 a pop, even some libraries don't bother. Not available online. But, herein are the runes of microchip sorcery. New edition out in February. —PW

E-Business Technology Forecast

PricewaterhouseCoopers Technology Centre. 1999; 237 pp. or electronic format. $300. PricewaterhouseCoopers (see above).

E-business defined and addressed as a discrete technology. A tip of the hat to the newest business platform.

Simulcast paging systems use multiple transmission modes. If any incoming signal path is blocked, others carry the signal to the pager. Satellite links obviate the need for telephone lines, and cost less.



The Vermont Guide to Computer Terms

Illustrations by Malcolm Wells

Floppy Disk: What you get from piling too much wood.

Lap Top: Where little kids feel comfy.

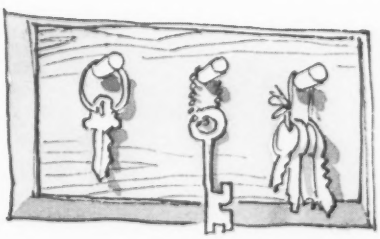
Dot Matrix: Farmer Matrix's wife.

Byte: What black flies do.

Mega Hertz: When you're not careful downloading.

Download: Get the firewood off the pickup.

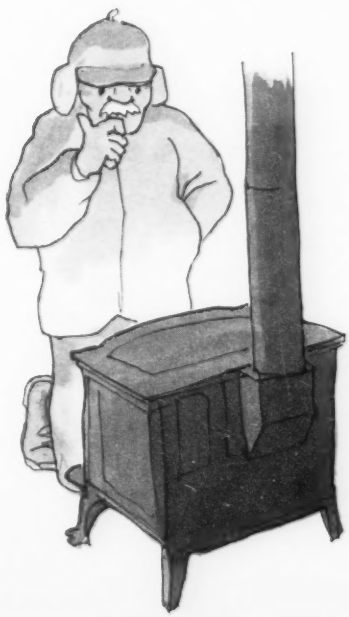
Monitor: Keep an eye on the wood



Keyboard: Where you hang your keys.

Modem: What you did to the hay fields.

Hard Drive: Getting home in mud season.



Log On: Make the woodstove hotter.

Log Off: Don't add wood.

Wild Duck Review

Literature, Necessary Mischief, & News

Casey Walker, ed. $24/year (4 issues). PO Box 388, Nevada City, CA 95959, 530/478-0134.

***Wild Duck Review* is an audacious and brilliant quarterly. It is also a literary tour de force—edited, compiled, and published by one person, Casey Walker. Lovers of literate thought will want to subscribe. The Summer 1999 issue (single copies $4, bulk rates available) is devoted to biotechnology; it asks whether we are passing from a world of "born" to a world of the made ("A world of made is not a world of born" —e.e. cummings). Walker assembled an exceptional group of scientists, activists, theologians, and writers to explore what may be the defining technology of the coming century—the corporate-led effort to reprogram genetic code in all life forms, within and across species barriers.**

Essayists include Wendell Berry, Chris Desser on unnatural selection, Jack Turner on modern forests, David Petersen on animals and hunting. Walker interviews, among others, Stuart Newman, Andrew Kimbrell, Rich Hayes, Freeman House, and Kristin Dawkins. The issue is one of the best single compilations and summaries of the dilemmas stealthily arriving at our doorstep courtesy of "life science" corporations and academic institutions. The centerfold is a broadsheet with access to books, publications, organizations, and Web sites devoted to biotech issues. —Paul Hawken

"The problem, as it appears to me, is that we are using the wrong language. The language we use to speak of the world and its creatures, including ourselves, has gained a certain analytical power (along with a lot of expertish pomp) but has lost the power to designate *what* is being analyzed or to convey any respect or care or affection or devotion toward it. As a result we have a lot of genuinely concerned people calling upon us to "save" a world which their language simultaneously reduces to an assemblage of perfectly featureless and dispirited "ecosystems," "organisms," "environments," "mechanisms," and the like. It is impossible to prefigure the salvation of the world in the same language by which the world has been reduced and defaced. —Wendell Berry

"We can look at the outcome, the end products of evolutionary processes, and appreciate the ways in which genes latched onto all sorts of things that originated through epigenetic mechanisms. However, if you try to understand the structure of the system by just looking at the genes, you will be terribly confused. Life forms did not arise from incremental pathways of small genetic changes. Instead, genes basically insinuated themselves into processes that genes themselves did not originate—a phenomenon ignored in neo-Darwinian notion of the incrementally achieved "genetic program." In other words, genetic integration is a post hoc scaffold that stabilizes life forms, but is very different from a program. Looking at organisms this way allows us to appreciate the fact that there are aspects of our biology that have been consolidated by genetic evolution even though genetic evolution did not originate those aspects. —Stuart Newman

Ag Biotech: Thanks, But No Thanks?

Frank J. Mitsch and Jennifer S. Mitchell. Deutsche Banc Alex. Brown, July 12, 1999. Downloadable at www.biotech-info.net/Deutsche.html.

The most serious critique of and blow to biotechnology this decade was issued in July by one of its strongest advocates, Deutsche Bank. The report wasn't about ethics, but about what the financial industry calls "hits" to earnings and valuation. Having issued "buy signals" on many of the companies commercializing ag biotech, Deutsche Bank stepped on the brakes for the simple reason that the industry was starting to suffer from "an incurable attack of market forces" (Amory Lovins's phrase). Deutsche Bank clearly summarizes the developments that have thrown off the economic models used to justify the very high valuations received by companies such as Monsanto and Pioneer-HiBred.

The critical factor is development of a two-tiered pricing system in the grain market. Due to growing demand from European and Japanese companies for uncontaminated grain, genetically modified (GM) corn and soy are selling at a discount, while non-modified seeds are selling at a premium. Economic gains realized, or hoped for, out in the field (due to herbicide or pest resistance) are being wiped out at the grain elevator. Unless GM yields become considerably better, the farmer planting GM crops will earn less money.

As this movement gains momentum, what company can thumb its nose at a concerned public? Big and small food companies are backpedaling under pressure from boycotts and stigmatization, announcing they are or will go GM-free. As an executive from Nestlé told representatives of GM seed companies: "Why should we take a bullet for your corn?" In other words, GM foods are value-detracted instead of value-added.

The report gets things wrong too. It repeats the industry saws that genetically modified organisms are the only way to feed a growing hungry world, or that without them, we will need to use more chemicals. Nevertheless, it clearly defines the uphill struggle faced by the life-science giants as they try to channel their proprietary products into the human food chain. —PH

"We are willing to believe that the GMO crops are safe and, in fact, may provide a benefit for the environment. What we are saying, however, is that the perception wars are being lost by industry, one battle after another....Perception is far more important than reality for this issue.

"In the United States, the GMO debate would have occurred earlier this decade had the FDA opened up the question for debate. Rather, in 1992, the FDA unilaterally decided (in its opinion) that as long as a GM food is no more toxic [or] allergenic, or any less "substantially equivalent" than its standard counterpart, it need not be labeled to show the process that created it. That decision is in sharp contrast to European labeling laws, introduced in 1997, which require that any food must be recorded as a GM one if it contains residues of engineered DNA or protein. While the science behind the GMOs may say one thing, we believe the lack of public discourse back then should lead to more heightened scrutiny when it does come.

"When all the above is taken into consideration, we believe the prudent

Choose Your Sperm

—Globalocal Access

Adapted from *COLORS*, Number 34, oct-nov 1999. The "Status (for a lucky few)" issue. Subscriptions $36/year (6 issues). 718/392-7477, speedsubs@aol.com, www.speedimpex.com.

Cryogenic Limited, New Delhi, India. All sperm must come from men with three years of college. **Fairfax Cryobank, Fairfax, USA**. Postgraduate sperm costs $290 ($40 more than BA donor). Sperm also sorted by tastes like car-make preference. **Family Planning Technical Guidance Agency in Kunning, China** has a "Notables Sperm Project": "common," from men with low-paying jobs; "premium" from professionals; and a special athletic brand.

Cryobank International, Altamount, USA. Guarantees all donors over 1.8 meters tall. **Genesis Fertility, Vancouver, Canada**. If below the magic 1.8 meters and weigh more than 180 kg, you can't donate.

***Le Centre d'Etude et de Conservation des Oeufs et du Sperme Humains*, Paris**. Sperm must come from a stable family, which is wife or girlfriend and at least one child.

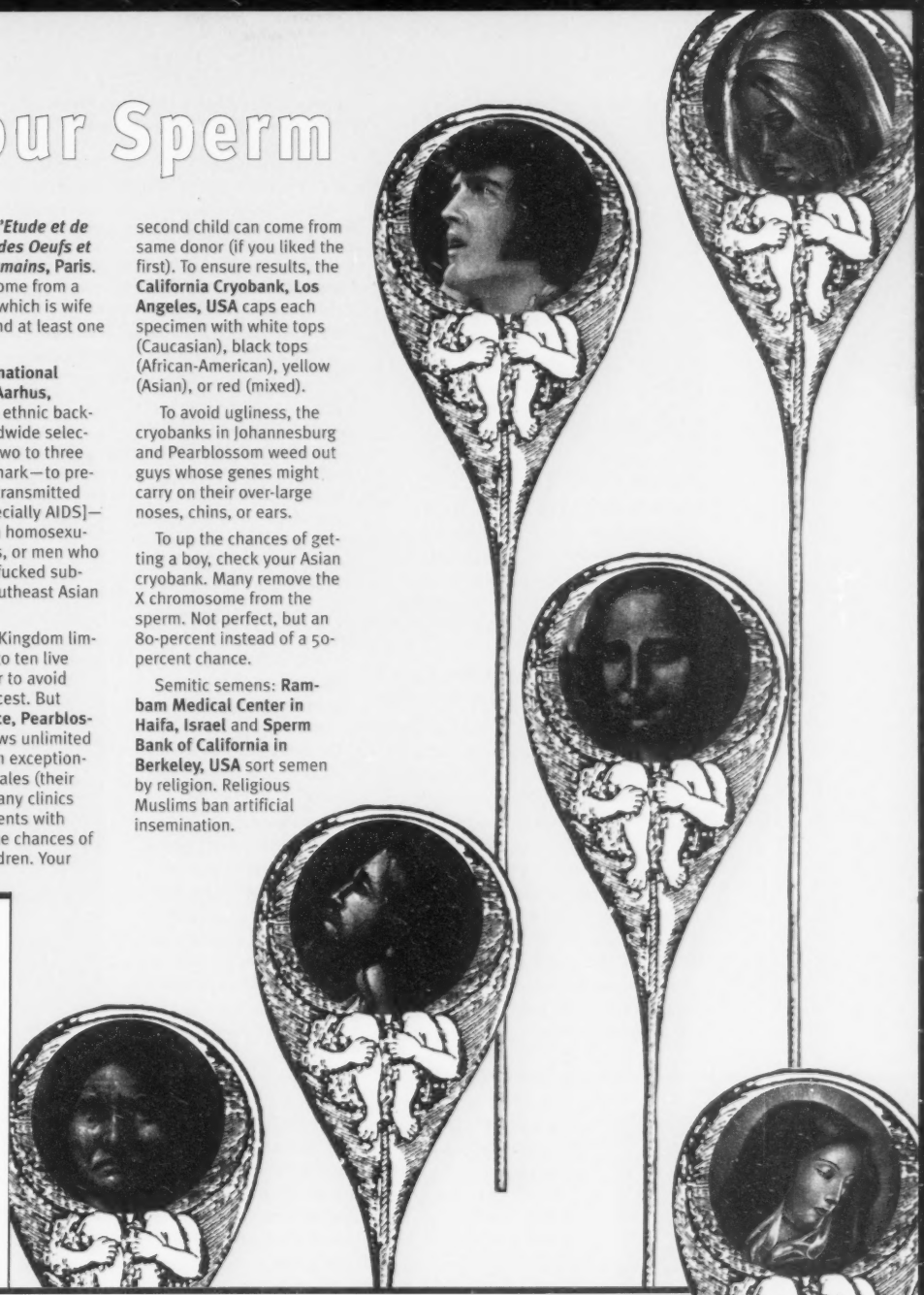
Cryos International Sperm Bank, Aarhus, Denmark. 200 ethnic backgrounds, worldwide selection, ships in two to three days. (In Denmark—to prevent sexually transmitted diseases [especially AIDS]—no sperm from homosexuals, drug users, or men who have recently fucked sub-Saharan or Southeast Asian residents.)

The United Kingdom limits one donor to ten live births, in order to avoid inadvertent incest. But **Heredity Choice, Pearblossom, USA** allows unlimited donations from exceptionally creative males (their only stock). Many clinics will match parents with sperm to up the chances of look-alike children. Your second child can come from same donor (if you liked the first). To ensure results, the **California Cryobank, Los Angeles, USA** caps each specimen with white tops (Caucasian), black tops (African-American), yellow (Asian), or red (mixed).

To avoid ugliness, the cryobanks in Johannesburg and Pearblossom weed out guys whose genes might carry on their over-large noses, chins, or ears.

To up the chances of getting a boy, check your Asian cryobank. Many remove the X chromosome from the sperm. Not perfect, but an 80-percent instead of a 50-percent chance.

Semitic semens: **Rambam Medical Center in Haifa, Israel** and **Sperm Bank of California in Berkeley, USA** sort semen by religion. Religious Muslims ban artificial insemination.

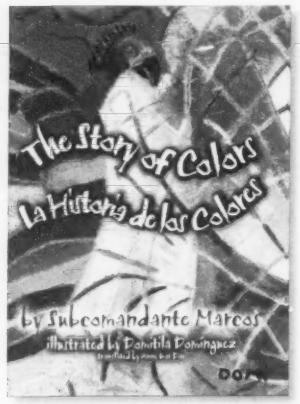


observer will come away with a longer time horizon for consumer acceptance of ag-biotechnology. Experience has shown...that fantastic profits may not be realized. This lengthens the payback period for the massive investments already made and decreases the ROI [return on investment]. The huge prices paid for seed companies depend on the value added and rapid rate of technology development that GMOs promise. It also strips out some of the former...enthusiasm for investing in ag-biotech today that led to very impressive multiples being paid.

Farmageddon
Food and the Culture of Biotechnology

Brewster Kneen. 1999; 240 pp. $16.95. Consortium Book Sales.

This lucid, take-no-prisoners attack on ag biotech draws on thinkers as diverse as Illich, Foucault, and North Dakota organic farmer Fred Kirschenmann. A farmer and longtime analyst of food systems, Kneen is a fount of inside information on the industrial giants that want to feed us. His most important declaration is that biotechnology is not about life. Full stop. Even some of its harshest critics will say that there may be some benign uses for biotechnology. Not Kneen. Any attempt to dominate life (whether by monopolies, terminator-seed technology, patents, or transgenic manipulation) is, for him, the limitation and extinguishing of life. In Illich's terms, a newly discovered scarcity—life—is being manufactured by companies. And they have come just in time to fill that need for you and me. *Bon appetit*. —PH



The Story of Colors/*La Historia de los Colores*

A Folktale from the Jungles of Chiapas

Subcomandante Insurgente Marcos; illustrated by Domitila Domínguez. (Translated by Anne Bar Din.) 1999; 40 pp. $15.95. Cinco Puntos Press.

This review is by Graham Mullins (age 7 years) as dictated to grandma Diana Hadley:

"Tell Peter Tata's magazine that this book is about how all the colors got made, and got saved by being stretched onto the feathers of a macaw. The gods in this story are weird. They look like cats and they're kind of mean and lazy, and they're bored because there aren't any colors. In the end, though, they work things out pretty well, because they let the colors make more colors and then the *cieba* tree saves the colors from the rain and then the gods put all the colors on the macaw, so there's a place for all kinds of colors and all kinds of people. What I want to know is why Subcomandante Marcos is fighting in the jungle? Why does he keep his face hidden all the time? Mama, where's my ski mask?"

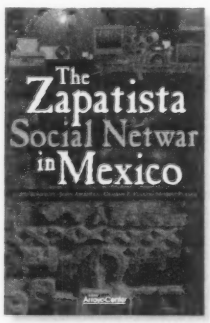
This review is excerpted from "The Story of Colors," by JoAnn Wypijewski. Reprinted with permission from the April 19, 1999 issue of The Nation *magazine (see access).*

...Representative Ralph Regula [R-OH] said this children's story—presented in Spanish and in English, illustrated with boldly hued, fantastical images of birds and beasts; of gods bearing little resemblance to those in pre-Columbian art; of people smoking or lying in each other's arms—by the Zapatistas' inspired pamphleteer with trademark ski mask and pipe, "isn't appropriate for American children." In commenting on the National Endowment for the Arts' recent decision to break its $7,500 promise to Cinco Puntos Press for production of the book, Regula said that NEA chief William Ivey did "exactly the right thing in stopping the grant."

He's right. The decision got the book on the cover of the *New York Times*; within twenty-four hours the Lannan Foundation came forward with an even bigger sum, $15,000; and booksellers ordered 3,000 copies. This—on top of the 500 bought directly by people who kept phones trilling for a day and a half at Bobby and Susie Byrd's home-publishing office in El Paso—guaranteed a sellout of the first printing of 5,000.

The Byrds protested Ivey's virtually unprecedented decision; it came after the award had been granted and all that was left was to cut the check. But without it they wouldn't now be planning a second run of 6,000, maybe 10,000 copies. For small publishers, getting their books noticed and getting people to buy them has always been more important than government beneficence.

And for Colectivo Callejero, the artists' collective in Guadalajara that first published *La Historia de los Colores* two years ago and was granted all royalties from the US edition



The Zapatista Social Netwar in Mexico

David Ronfeldt, John Arquilla, Graham E. Fuller, and Melissa Fuller. 1999; 168 pp. $15. Rand, 1700 Main Street, Santa Monica, CA 90407. 800/462-6420, 310/451-7002, www.rand.org.

The information revolution is leading to the rise of network forms of organization, where small, previously isolated groups can link up and conduct coordinated joint actions as never before. In turn, this is leading to a new mode of conflict—"netwar"—where protagonists depend on network forms of organization, doctrine, strategy, and technology. Many actors across the spectrum of conflict—terrorists, guerrillas, criminals, social activists—are developing netwar designs and capabilities. The Zapatista movement in Mexico provides a seminal case of social netwar—the first major case anywhere of a "swarming" by a large multitude of militant NGOs in response to a distant upheaval. A violent guerrilla-like insurgency begun in Chiapas in January 1994, and the Mexican government's heavy-handed response, aroused many civil-society activists, and mutated into a nonviolent but no less disruptive social netwar.

This case study [prepared for the United States Army] examines the emergence of the Zapatista netwar, effects in Mexico (creation of extraordinary pressure for democratic reforms), and implications for anticipating new social netwars beyond Mexico. Rather than inspiring radical activists around the world to think of old models of struggle to "crush the state," the new concept seeks to draw on the power of networks to strengthen "global civil society" to counterbalance state and market actors. "Many authoritarian regimes are likely to prove vulnerable to social netwar"....

Authoritarian regimes can be expected to wage counterwar (dummy NGOs, arrest, disinformation, etc.). In coming years, a major new global peace and disarmament movement could arise from a grand alliance among NGOs and other civil-society actors attuned to social netwar, which is "fundamentally anti-establishment." —*Future Survey* (see access)

> "• Hierarchies have a difficult time fighting networks.
> • ...It takes networks to fight networks.
> • ...Whoever masters the network form first and best will gain major advantages.

by Subcomandante Marcos, more American sales will help finance a reprinting of the Mexican edition (only 2,000 originally run)....

So, more money for Cinco Puntos, more money for the Colectivo and, for us (and those delicate "American children"), more opportunity to read this magical book....

Since they burst into public consciousness on January 1, 1994, the Zapatistas have often been discussed as if they were an art installation: the *guerrilleros* in the mountains, unseen but everywhere represented, most famously in communiqués but also in masked dolls backpackers return with from Chiapas; in snacks and condoms and other assorted goods bearing their image that suddenly appeared on the streets of Mexico City...; in the hearts of the world's radicals longing for a reminder that just because, as Marcos wrote, the enemy is "shoving the struggle for democracy, liberty, and justice into the corner reserved for utopias and impossibilities," it needn't be so.

...Marcos has been telling the story of colors in different ways since he first explained the Zapatista struggle to a curious world. In a February 14, 1994 letter...Marcos wrote:

The oldest of the old of our peoples spoke words to us, words that came from very far away, about when our lives were not, about when our voice was silenced. And the truth journeyed in the words of the oldest of the old of our peoples. And we learned through the words of the oldest of the old that the long night of pain of our people came from the hands and words of the powerful, that our misery was wealth for a few, that on the bones and dust of our ancestors and our children, the powerful built themselves a house, and that in that house our feet could not enter, and that the light that lit it fed itself on the darkness of our houses, and that its abundant table filled itself on the emptiness of our stomachs, and that their luxuries were born of our misery....

...In the word of the oldest of the old also came hope for our history. And in their word appeared the image of one like us: Emiliano Zapata. And in it we saw the place toward which our feet should walk in order to be true, and our history of struggle returned to our blood, and our hands were filled with the cries of our people, and dignity returned once again to our mouths, and in our eyes we saw a new world.

Not a folk-tale new world; folk tales aren't dangerous.

← "El viejo *Antonio* señala una guacamaya que cruza la tarde. "Mira," dice. Yo miro ese hiriente rayo de colores en el marco gris de una lluvia anunciándose. "Parecen mentira tantos colores para un solo pájaro," digo al alcanzar la punta del cerro.

"Old Antonio points at a macaw crossing in the afternoon sky. "Look," he says. I see a brilliant streak of colors in the gray mist of a gathering rain. "You wouldn't believe one bird could have so many colors," I say as I come to the top of the hill.

"A faction of pro-Zapatista radicals based in New York, drawing on ideas coming out of radical theater circles and inspired by the shock tactics of Earth First! and ACT-UP, has begun to advocate "electronic civil disobedience." The intent is to go beyond the electronic protest tactics (e.g., e-mail and fax campaigns) that Zapatista activists have emphasized so far, and focus on creating "virtual sit-ins" that may shut down sensitive Web sites and Internet servers in Mexico and/or the United States, in order to "disrupt the flow of normal business and governance." The protagonists of this view are trying to create software for use on anonymous offshore servers—"ping engines, spiders, and offshore spam engines"—that will enable them, and any other individual anywhere who wants to join, to conduct what amounts to massive, remote-control, standoff, swarming attacks in cyberspace....The prospect of this happening is not being well received by the mainstream of the Zapatista movement.

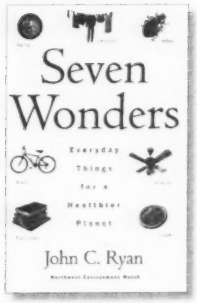
"In Saudi Arabia, the ruling family keeps tight control including through heavy surveillance and security measures. But an underground exists, and people's access to modern telecommunications is improving as a result of new connections to the Internet and plans for AT&T to upgrade the cellular telephone grid. Thus, opportunities may grow for an indigenous dissident movement to emerge and gain links to outside fundamentalist and even secular democratic forces. At the same time, the more Saudi Arabia's telecommunications systems become connected to the outside world, the higher the costs of repression and control may become for the ruling regime.

Future Survey
A Monthly Abstract of Books, Articles, and Reports Concerning Forecasts, Trends, and Ideas about the Future

Michael Marien, ed. $89/year (12 issues). World Future Society, 7910 Woodmont Avenue, Suite 450, Bethesda, MD 20814. 800/989-8274, 301/656-8274, www.wfs.org/fsurv.htm.

***The Nation* magazine.**

Katrina vanden Heuvel, ed. $52/year (47 issues). The Nation, PO Box 55149, Boulder, CO 80322. 800/333-8536, info@thenation.com. Portions of each week's issue can be viewed at www.thenation.com.



Seven Wonders

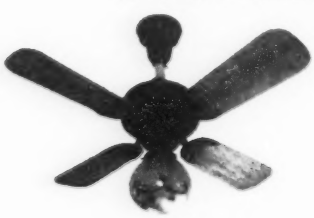
Everyday Things for a Healthier Planet

John C. Ryan. 1999; 98 pp. $12.95.
Sierra Club Books.

A couple of years ago, while I was doing something else, I heard snatches of a radio program in which Alan Durning, the director of Seattle's Northwest Environment Watch, talked about the "Seven Sustainable Wonders of the World." Clever concept, I thought, but afterward I could only remember three of his wonders:

The bicycle: The most energy-efficient form of transport ever devised. It doesn't emit pollution, it runs on renewable energy, it makes its user healthier, it's easy to repair, it requires little in the way of pavement or parking lot, and 80 percent of the world's people can afford one. (Only 10 percent of the world's people can afford a car.)

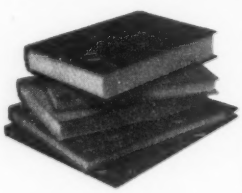
The clothesline: Even more affordable than the bicycle, runs on solar energy, no wires, no electricity, no pollution, and your clothes come out smelling sweet.



The ceiling fan: The air conditioner of the tropical world, which I fondly remember turning slowly and romantically in rooms all over India. A fan makes a space feel 9°F cooler than it really is. A typical ceiling fan draws no more than seventy-five watts, about as much as a single incandescent light bulb, only one-tenth as much as an air conditioner. And it doesn't make the air stale and clammy, the way air conditioners do.

Now what were Alan's other four Sustainable Wonders? I couldn't remember. I kept meaning, and forgetting, to call him and ask. So I was delighted to see that he passed his idea on to a colleague, John C. Ryan, who has just put out a little book called *Seven Wonders*. Here are the other four:

The condom: Protects against some of the world's worst diseases, gives potential parents control over the size and timing of their families, helps control population growth. "Those are big jobs for a flimsy tube of rubber," says Ryan. One sustainability problem with this item is that it's discarded after just one use. But it's made from natural rubber, a renewable resource.



The public library: The written wisdom of the world at anyone's fingertips! The average American pays $20 a year in taxes to support public libraries, and can save that much by borrowing instead of buying just one or two books. A book that is loaned ten times cuts not only cost but paper use per read by a factor of ten.

Pad Thai: The highly seasoned Asian dish made of noodles, garlic, and vegetables, sometimes with bits of chicken or shrimp thrown in. Ryan doesn't mean to celebrate that particular dish so much as the basic principle of "peasant" cooking around the world: Start with starch, mix in veggies, add great seasonings, and use meat sparingly if at all. Could as well be tortillas and beans, curry and rice, or spaghetti and tomato sauce. Healthy, cheap, do-it-yourself, easy on the planet, delicious.

The ladybug: Constantly searching out and destroying plant pests, without charge, without environmental damage. Your average ladybug scarfs up forty to seventy-five plant-sucking aphids a day. Multiply that by 75,000 beetles per gallon, which farmers can order through the mail, and you've got one heck of an efficient pesticide. Something like 98 percent of sprayed chemical pesticides never even hit a pest, but ladybugs zoom right in on the aphids and nothing but the aphids.

After I finished reading Ryan's book, which is full of interesting facts about these wonders, I started seeing Wonders of Sustainability all around me. There's no reason to limit the list to seven. Here are some more:

The root cellar: Temperature-controlled by the Earth, a way of storing potatoes, carrots, onions, cabbage, squash, turnips, beets, apples, dahlia tubers, and gladiolus corms (that's what goes in my root cellar) without moving parts, canning jars, boiling, or freezing.

The basket: Someone once told me that no one has yet succeeded in mechanizing the making of baskets. Whether or not that's true, baskets—made all over the world by skillful hands out of renewable, biodegradable material—are lightweight, strong, beautiful, and reusable over and over.

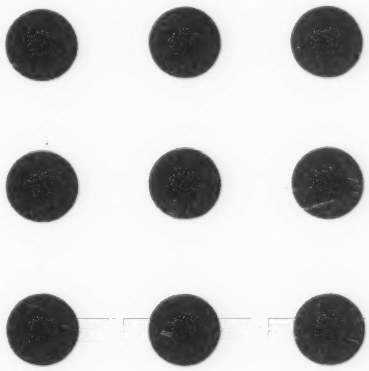
The olive tree: It can live hundreds or thousands of years in dry, hot climates; like all trees it recycles carbon dioxide breathed out by us animals and turns it back into the oxygen we need; its roots hold the soil; its leaves break the impact of the rains; and it produces tasty, healthful olive oil.

The sari: ...and the sarong and the shawl, made of uncut, unsewn cloth, colored and patterned as gorgeously as a butterfly, gracefully draped, comfortable, cool, adaptable. You can suspend babies or melons or firewood in it. You can hitch it up for wading, tuck it around your legs for bicycling or running, pull it over your face if you want shade or to be modest or to flirt. Never out of style. Easy to wash and dry. One size fits all.

The compost pile. The knitting needle. The canoe. This is fun. I could go on with this list, and so, probably, could you.

Outbursts of Creativity: The Nine-Dot Problem

Adapted from *Conceptual Blockbusting*, by James L. Adams (see page 109). Suggested by Amory Lovins



Without lifting the pencil from the paper, draw no more than four straight lines which will cross through all nine dots.

Try it before turning the page!!

What do all these wonders have in common? Well, their kindness to the Earth and to human health is what qualifies them for a sustainability list. They are accessible to anyone, inexpensive to obtain and maintain. Many of them serve not only practical but also esthetic needs; they satisfy the eye, the palate, or the soul. Most are old in concept, though they may have modern variations. Something like them has evolved in many different cultures. Most are objects you can buy, but usually from a local maker, not a multinational corporation.

Maybe that's why we don't much appreciate the humble, sustainable wonders around us. Their value is too obvious to need touting. You only have to spend billions "marketing" something if its worth is in doubt.
—Donella H. Meadows

"Those old-fashioned manila envelopes that close with a string are the cutting-edge of Earth-friendly packaging. Covered with spaces for writing and crossing out addresses, they are designed to be reused 30 times or more (before being recycled). They put modern recycling—and the shipping industry—to shame.

"In 1960, less than a fifth of American households, and only an eighth of Canadian households, had automatic dryers. Today three fourths of both nations' households have dryers; only 15 percent of U.S. households even occasionally line-dry their clothing. Many apartment buildings and homeowners' associations have gone so far as to ban clotheslines entirely. They apparently fear that sweet-smelling, freshly washed clothes billowing in the sun will somehow bring down their property values.

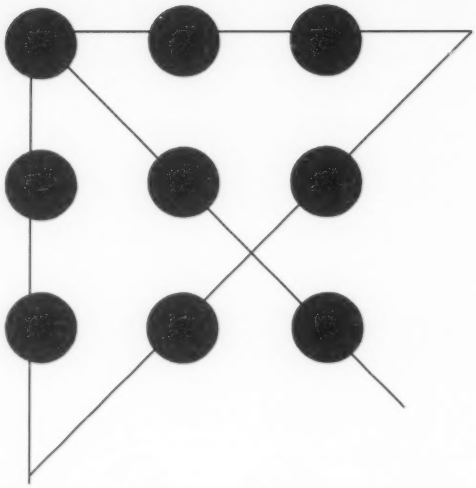
...With the mix of fuels burned to generate U.S. electricity, the average household dryer puts almost a ton of climate-damaging carbon dioxide into the atmosphere per year. (The same dryer in Canada would send up less than 500 pounds [about 200 kilograms] of carbon dioxide but create more river damage and nuclear waste.) The heating coils in most dryers (20 percent of American dryers heat with gas) require about three kilowatt-hours of electricity per load, enough to read by the light of a 60-watt bulb for two days or work on a laptop computer for a week.

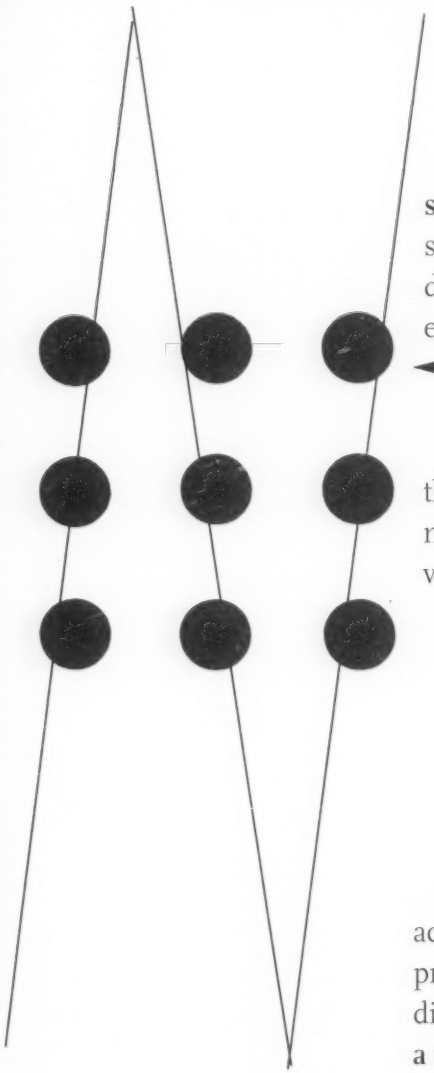
"Condoms that include spermicide usually contain nonoxynol-9, a chemical that kills off not only sperm and diesase-causing bacteria, but the "good" bacteria that keep other bacterial populations in check. As a result, regular use of nonoxynol-9-coated condoms can triple a woman's odds of getting urinary tract infections....

While researchers learn more about the endocrine-distrupting effects of chemicals like nonoxynol-9, condom users wanting to avoid the health risks associated with spermicide can look for plain lubricated condoms. (Irritation caused by unlubricated condoms can also lead to urinary tract infections.) And to minimize the risk of pregnancy, it is important to follow the instructions on the condom package to prevent spills or tears. The supercautious can also use condoms in combinations with another contraceptive for double safety.

Break the boundaries, the mental fences that artificially contain the nine-dot problem.

Many people stop with this solution. So *that's* the answer! But what if there is no one answer? James Adams collected these equally "correct" solutions:





Challenge the relationship of the parts! This smart-ass trickster sees the dots as fat; uses their edges. Only three lines!

Another trickster sees the LINE as fat (and the nine-dot pattern as very, very small). Only one line!

May 30, 1974
5 FDR
Roosevelt Rds. Navosa
Ceiba, P.R. 00635

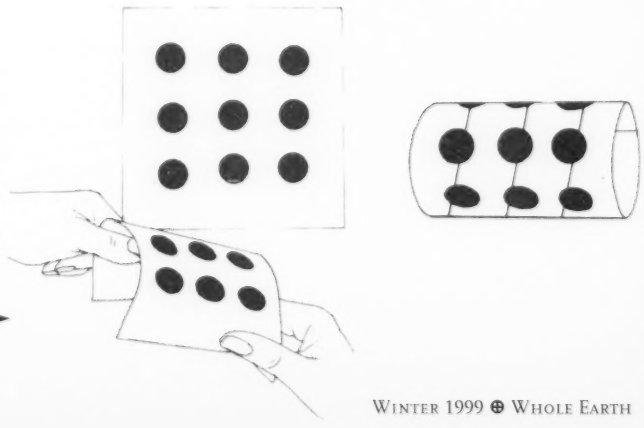
Dear Prof. James L. Adams,
My dad and I were doing Puzzles from "Conceptual Blockbusting". We were mostly working on the dot ones, like ⋮⋮ My dad said a man found a way to do it with one line. I tried and did it. Not with folding, but I used a fat line. I doesn't say you can't use a fat line.
Like this

P.S. acctually you need a very fat writing apparatice

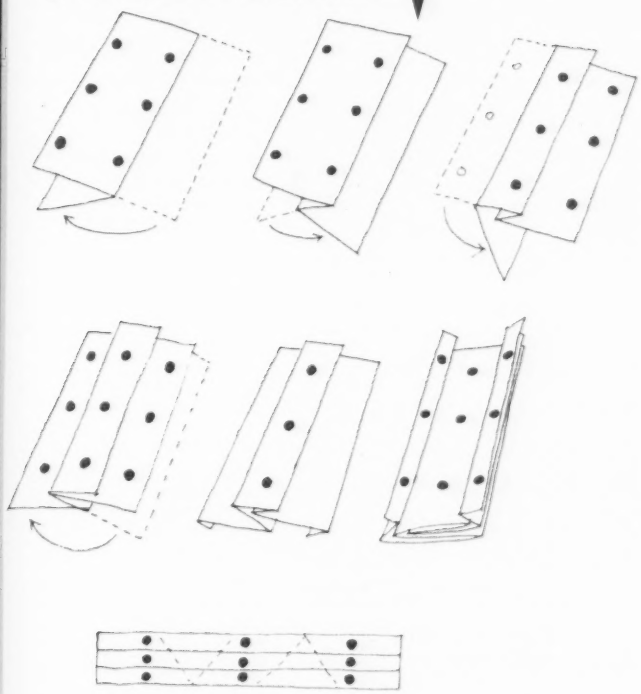
Sincerely,
Becky Buechel
age: 10

Was the limit accepting the problem as two-dimensional? **Try a third.**

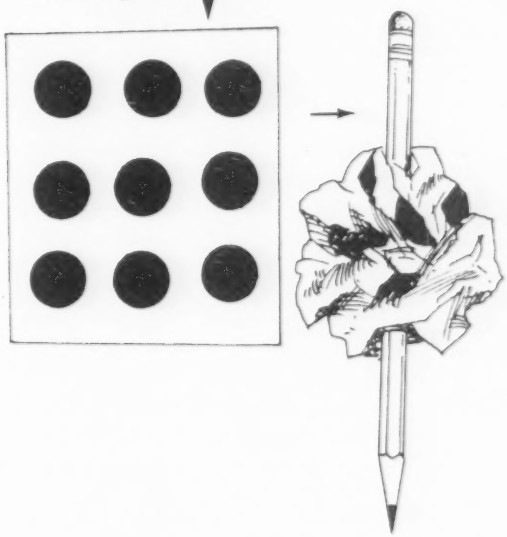
Here's the tube-and-spiral solution.



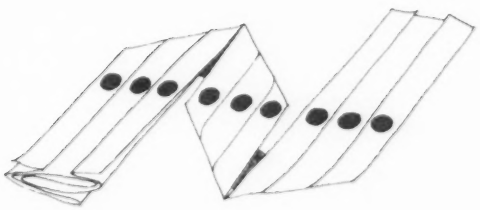
Here's an ingenious **fold-the-pattern-into-a-solvable-one**.



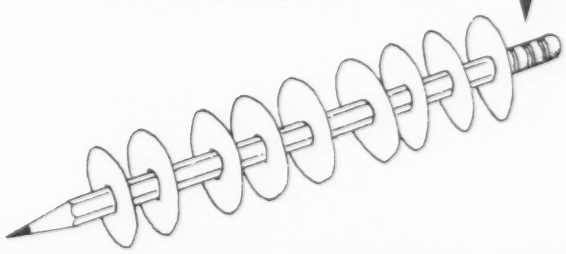
Frustrated? Try the casino "**play-until-you-win**" solution. Draw dots as large as possible. Wad paper into a ball. Stab with pencil. Open up and see if you did it. If not, try again!

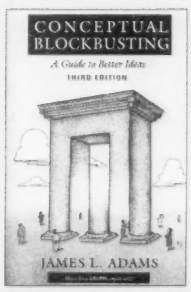


The truly destructive/creative outburst: **destroy the pattern altogether**. Cut the dots apart, tape back together, draw line.



Cut the dots apart, pierce with pencil.



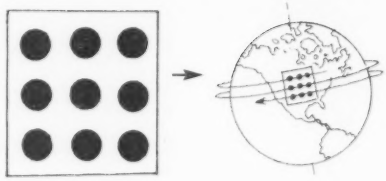


Conceptual Blockbusting
A Guide to Better Ideas
James L. Adams. 1986 (third ed.); 161 pp. $13. Perseus Books.

Reconceptualizations and "problemizations" to help you run around, over, and through mental blocks thrown up by habit and schooling. Exercises for interpersonal relations in a one-person group. Careful explorations with the mind-mirror. *Blockbusting* is like a secular Buddhism, with visualizations and logic-koans to derail one-way trains of thought.
—PW and MKS

More

The *Whole Earth* solution:
one line traveling in circles.

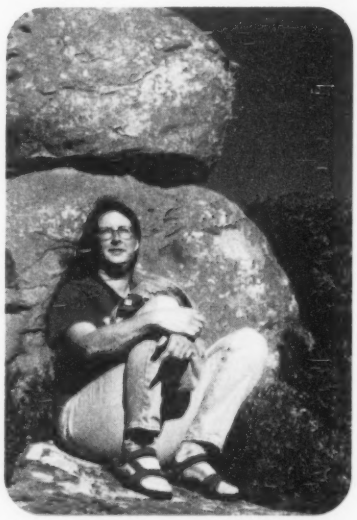


Gossip

All we can do at this time of year is thank all those who, each in his or her own way, have expressed love for our work. This is the tenth issue since *Whole Earth*'s financial "demise" and rebirth. I've lost my street-cynicism from two and a half years of kindness and generosity from amazing long-term—and some new—readers. Readers well know (and if you don't, call and talk to Alex) how problematic it is for a nonprofit magazine to exist at all. So I've got to say, with a tinge of desperation: Please find us new subscribers, especially college libraries; find local stores to carry us; tell local college and high school teachers we'll make a deal for classrooms; send suggestions and yes, gifts to cover what almost all philanthropists avoid, funds for operating expenses. OK? OK.

It's another fall. The Steller's jays have landed outside the window, evaluating the apples. Mom deer "One" has two fawns again. Mom Two hasn't shown up yet. Oddly, while others focus on the ticktocking days and minutes, it feels like a moment of timelessness; maybe the pause before La Niña storms. Sure, each fall's unique. A white-winged tern showed up on the coast. But, with gracious accommodation, fall is familiar in its essentials; and local seasonal time abides.

Inspired, Nicole bought us a fire kit at the Sunol-Ohlone Regional Wilderness nature center. The mule-fat bush branch is whittled into the straightest, smoothest fire drill. The hearthboard is a cream-white fibrous slice of sotol (a yucca-like plant). Supervising naturalist Norm Kidder, who'd made the fire kit, shaved a few more slivers off the drill and spun it in his huge hands, pressing into the sotol. Sawdust excavated by the drill fell through a tiny slot cut into the side of the hearthboard, first brown, then (once ignited) extruded and black. Transferring and folding the smoking sawdust into a bundle of fibrous tinder, Norm blew not too much, not too little, until it burst into flames. Hearing this story, I wished, like Ghost Dancers, for that time of return, a time when attention to living detail was valued and gentle and interesting and useful all at the same time. Thanks folks, and good evening to all.



Hilarie Gardner's returned. She joined the WELL when it was wired to the *Whole Earth Review*, as a refugee from the Wheel of Fortune game show (where she won), and just in time for the 1989 Loma Prieta earthquake. Since 1995 (two years after *Whole Earth* sold its interest in the WELL), she's worked eleven start-ups for online, software, and Internet service providers. Exactly a decade after leaving "the family," she's come back to help us as business manager. Between them, Hilarie and her husband (John Coate, online service manager for the *San Francisco Chronicle*) have raised six kids. If community continuity and history can be this pleasant, then recycling is definitely the way to go.

Joan McIntyre assembled *Mind in the Waters*, a celebration of whales and dolphins, in 1973. This never-surpassed book spurred the movement to save cetaceans. She stopped by to remind us of her most infamous French kiss (*CoEvolution Quarterly*, Spring 1977).

Clockwise from bottom left: Peter Warshall; Anders Olsson; Alex Gault; Mike Stone; Jonas Lagneryd; Nicole Parizeau. *Whole Earth* has partnered with the Bioneers since we returned to print. Each year their conference has more practical visionaries per square foot than any other get-together we know. From Värmland, Sweden, Jonas Lagneryd and Anders Olsson visited Bioneers and *Whole Earth*. (Managing editor Mike Stone's grandparents came from Värmland; he was surprised to learn it's as much forest as *värms*.) Jonas and Anders are project managers for Miljöaktion (Environmental Action), a local joint project for county-wide sustainable futures. Senior editor Nicole Parizeau and her husband put them up for a night. Such wonderful houseguests that the next day we lent them a truck and sent them on a quest to the giant coastal redwoods. —PW

Book Brawl III

Small-Town Book Lovers

To the Editor, *Whole Earth*:

Buyouts of publishers by big bookstore chains worry me too, but as for never buying from Barnes & Noble again, sorry, it's not that simple.

When I moved to the Augusta, Maine area twelve years ago, there were three bookstores within easy reach. Two were Mister Paperbacks (a regional chain) that carried somewhat different stock, so if you didn't find what you wanted in one, you could try the other. The third was a tiny independent that also sold role-playing and war-gaming materials. The owners later retired; the young man who bought the store kept it going for a year or so, then went out of business. Meanwhile a new independent, Apple Valley Books, had opened in nearby Winthrop.

A few years later, Barnes & Noble opened a store in Augusta. I stayed away for a while but was finally drawn in by reports from my book-loving friends, who adored the café and said that the store felt like a library; you could sit in nice chairs and read all day long and no one minded.

One of the Mister Paperbacks closed soon after Barnes & Noble opened. The other, and Apple Valley, are still open. I split my book buying, with some soul-searching each time, between Apple Valley Books and Barnes & Noble.

Apple Valley is wonderful. Rita and Eric, who run it, can get me virtually anything I want in a few days. They stock a great selection of books on alternative religions, they have a good children's section, they got me a book published in England with almost no overhead in shipping charges. They sell secondhand books in the basement, run school book fairs, and play a significant role in little downtown Winthrop. They do mail order and maintain a great Web site. I want them to stay in business for both personal reasons (I like them) and political reasons (I want local business to thrive). But I also want our local Barnes & Noble to stay in business, and here's why.

When I want a grammar book for use in homeschooling, or a computer book for my freelance programming, I can go into Barnes & Noble and find thirty or forty books in the ballpark of what I might want. I can spend an hour or a day browsing through the selections, reading whole chapters, figuring out which books best suit my tastes and purposes. This is especially important with computer books, which cost $40 to $60 apiece and which I am therefore not going to buy sight unseen. There is no way that a small independent bookseller in rural Maine could ever duplicate this service. And, despite Patricia Holt's assertions to the contrary [*Whole Earth*, Summer 1999], Barnes & Noble's employees, at least in this store, provide sympathetic and knowedgeable help for the asking.

I don't know how Barnes & Noble stores function in bigger cities, but in little Augusta, Maine, Barnes & Noble is just about the closest thing we have to a regional/community gathering place that is neither centered around some particular church or school nor filled with smoke and alcoholic beverages. I can go there on a Sunday afternoon and find half my acquaintances hanging around drinking coffee, browsing through books that they may or may not buy, and chatting with friends.

The store hosts all kinds of activities free to the public. (Yes, people tend perhaps to buy a book or two once they're in the door.) Chess night was so popular it was expanded from once a month to every Tuesday. There's a Celtic jam on the fourth Thursday; there are book signings by Maine authors, lectures on wild plant foraging, story times for kids, a book group, concerts, readings by local poets, a monthly poetry workshop. As much as I like Apple Valley Books, it is too small to serve these functions for its own community, never mind the region as a whole.

Not only that, but our local Barnes & Noble just feels nice to walk into. It is warm and inviting and cozy. There are books everywhere, and that's nice too. I think they must have secretly hired a feng shui expert to do the layout, the color scheme, and the lighting.

For the record, I never buy books, or anything else, via the World Wide Web. You could look at my book buying as a case of divided loyalties or reframe it as an enrichment. Apple Valley has one niche, Barnes & Noble has another, they overlap in the territory of bookselling. I hope they both stay in the neighborhood for a long, long time.

Yours,
Janie Matrisciano
Readfield, ME

Letters

***Whole Earth* is a conversation. Compliments, cavils, and corrections are welcome. Letters and e-mail may be (reluctantly) edited for space.**

Sterling Work

i just read the Viridian Manifesto of January 3, 2000, by Bruce Sterling [*Whole Earth*, Summer 1999].

i loved it. seems to be a pretty pragmatic approach to the problem he talks about with society's slanted

view, mainly media-induced i'm sure.

i wanted to thank him for writing it, i really enjoyed the read. ;)

Yossarian Holmberg (yossman)
Senior Systems Administrator
National Online Inc. (by e-mail)

I savor *Whole Earth* slowly. Are Human Rights Universal? (well, sort of); Biotech, Soybeans, Farms, Poor Monsanto (oh yeah?), Gorillas and Baboons and Books and Cities and and and....

At last I sat down with the Viridian Manifesto.

For some reason all the magazines I get these days tell stories of our inglorious demise. Of course, always trying their darndest to spin a little Hope at the end.

I have friends (well, acquaintances) who expect miracles that will regrow tropical rain forests in a week, enlightenment will be brought us by Star People from this or another galaxy.

I have many more friends who say, Oh, don't be so pessimistic, something, maybe technology, will rescue us at the last moment, it always has in the past (in the movies, yes). Actually, no. In the past civilizations have always crashed. The bigger the civilization, the bigger the crash. All such crashes have left areas of desolation. Ours is a world civilization....

Now here come the Viridians who want to seduce us into saving ourselves.

I can see it now. Collect large numbers of millions, hire an expensive public-relations firm (they do that sort of seduction all the time), buy TV time, advertising, talk shows, fashions...Yeah, I can see it.

But, a year later some other group, political or religious or both, will hire a more expensive PR firm, and we will all sway to their seduction.

Let's face it, we, humans, *Homo sapiens*, are just not very smart. Any species that seemingly willfully does everything it can to destroy its own nest is not viable. Is it?

Robert Wolff
Volcano, HI

WE Asked...

...so here I am.

Those color pages are great. Heisey's article ["Aerial Strivings," *Whole Earth*, Fall 1999] and his stunning aerial shots were a perfect choice to launch a color section.

Keep up the color and keep up the good work.

Ed LaChapelle
McCarthy, AK

A Tribute to Marcia—One of Many

Just a note to express how moving I found Marcia Fields's tribute to the life and passing of her husband, Rick Fields, in the most recent issue ["It Takes a Village to Die," *Whole Earth*, Fall 1999]. With so many finding common ground in the care they give to dying loved ones, Marcia Fields's story is one that needs telling again and again—if not for its bravery, then for its open-hearted humanity.

It is tragic that we find so much to link us in our shared pain, but this is the way of human life.

Rick Fields died as he lived, with principles and dignity, and his wife and friends are to thank for this as much as anyone. In death, as in life, we can still find community—and with community, great and abiding love to bear us into the world to come.

Robert Rhodes
Starland Hutterite Colony
Gibbon, MN

The Wrong Villain?

This is in response to the Farms section [*Whole Earth*, Summer 1999].

While we all can decry mega-animal-production facilities, feeling sorry for the American farmer may be misplaced.

Most older, competent farmers

had the chance, at least once, to be "small farmers," with adequate income, security, etc. In general they never gave it a second thought. Most wanted to be "big farmers."

Farm communities are no different from any other. You are judged by your neighbors and peers by how "successful" you are. Success is determined in a farm community by the size of your operation, and how it looks from the road. Who can judge quality of life or who knows your true net worth?

If you farm a few hundred acres, very few are going to ask you your opinion on anything, no matter how good or wise a person you might be. But if you farm several thousand acres that look good from the road, everybody is going to know who you are and want to hear your comments. You will be asked to be a director of the local bank, and your wife will likely be slim.

So it is not the government, the lending institutions, or even big, bad "agribusiness" that is the major culprit of the present agricultural situation. To paraphrase "Pogo," the American farmer has met the enemy, and he is them.

Addendum 1

In the past forty years if you owned approximately 300 good corn-belt acres without major debt, your average annual gross income would be at least $60,000. With older equipment, and moderate to low debt, you could have netted in excess of $30,000 annually—considering that your housing would be almost free (most 320-acre farms will have a decent house) and your transporta-

tion is mostly a tax-deductible business expense, and in most cases at least half your acres would be in a subsidized crop, for which you would have received several thousand a year from Uncle Sugar.

This is hardly a subsistence income! It is more like the corn-soybean-Florida rotation that farmers joke about.

ADDENDUM 2

While farmers are hardly oppressed, exploited, or "poor," they are certainly a minority. There are barely two million farmers, by the most tenuous definition. Less than half a million operate commercial, family farms. Most are part-time, "lifestyle" farmers, with generally two off-farm incomes. The typical commercial (full-time) farmer in the Midwest farms at least 2,000 acres—most of it rented. The average family farmer is certainly an admirable if somewhat mythologicalized person, who works hard and exercises considerable discipline, etc. But it would be hard to characterize him (and it is still mostly "him") as needy or oppressed. Over 85 percent regularly vote Republican!

ADDENDUM 3

Psychology and sociology aside, technology is probably the main cause of the current agricultural situation. Forty years ago (not long ago to an old fart like me) the typical Midwestern farmer had to hustle to get his few hundred acres planted and harvested with his three- to four-row equipment. Now, he can tend several thousand acres in less time with his computerized, customized, air-conditioned, twelve-row equipment. The impact of this on yields and everything else can hardly be overestimated! These 500,000, or fewer, full-time farmers, who produce over 85 percent of the total US agricultural production, can and do easily produce more agricultural goods than we need (or demand), or than the world can afford.

We desperately need a new agricultural policy. One that emphasizes the wise use of our natural resources—not one that attempts to preserve a mythical and largely defunct way of life. Unless we begin to face the facts, some of which I have tried to outline, we will never get it.

Name Withheld
Bloomington, IN

[The writer has been involved in a wide variety of agricultural endeavors since the 1930s, and holds a Master's degree in agronomy from a major university. He asked that we not use his name, as he still consults occasionally. What does that say about the farming community? —Ed.]

CORRECTIONS

The phone number we gave for the Institute for Social Inventions (*Whole Earth*, Fall 1999, p. 30) is actually the fax number. The correct phone number is +44 (0) 20 8208 2853.

The penultimate sentence of the "Declaration on Soil" (*Whole Earth*, Spring 1999, p. 25) should have read, "But we are also critical of many among well-meaning romantics, Luddites, and mystics who exalt soil, making it the matrix, not of virtue, but of life."

Marcia and Rick Fields (*Whole Earth*, Fall 1999, p. 90) were married nine months, not two years. Marcia, sadly, never celebrated an anniversary. Also, "The gates of Life as it exists are limitless. I vow to enter them" (p. 19) is a poor translation of "The Dharma Gates are limitless. I vow to enter them." We're responsible for the discombobulated prose.

We regret the errors.

ISSUE 99 THANKS

We are grateful to the following people for editorial, art, or business assistance with this issue.

FIRE

Debbie Anderson (California Department of Forestry & Fire Protection)
Earl Beaver (Chemist)
Janet Boese (American Chemical Society)
Dave Campbell (University of California, Davis)
Jennifer Coleman (Environmental Defense Fund)
Ron Condray (Retired Chemist)
Wendy Doniger (University of Chicago)
Claire Eaves (*New Scientist* syndication)
Anette Eriksson (Andrew Karnig & Associates)
Tina Estes (Global Business Network)
Johann G. Goldammer (*International Forest Fire News*)
Michael Gorman (University of Houston)
Charles F. Greene (Richard and Rhoda Goldman Fund)
Barbara Grygutis (Public Artist)
Guy Hand (Writer, Photographer)
Gerry Harvey (Defence Evaluation and Research Agency)
Ronnie Heiniger (North Carolina State University)
Andrew Hestelow (Stelco Ltd.)
Bruce Hirsch (Heller Family Foundation)
Diana L. Jordan (Browne-Larsen Travel)
Lloyd Kahn (Shelpter Publications)
Carol Lister (Anti-Defamation League)
Patty Lovera (The Center for Health, Environment and Justice)
Irving Mintzer (Global Change)
Francine Nichols (Study Circles Resource Center)
Southern Poverty Law Center
Richard Perez (*Home Power*)
John Steinberg (Pyrotechnics Guild International, Inc.)
Roseanne Taylor (California Department of Forestry)
Richard Weinstein (International Vintage Lighter Exchange)
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OTHER

Davis Baltz (Health Care without Harm)
Renata Brillinger (Slide Ranch)
Joy Carlson (Children's Environmental Health Network)
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Michele Hammond (Proofreader, New Mom)
Donald Ingber (Molecular Geodesics, Inc.)
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Andy Turnage (Association of Space Explorers)
Danielle Veith (*The Nation*)
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Announcing the Margaret Mead 2001 Awards recognizing community creativity for a new century

from the Margaret Mead Centennial Committee, Institute of Intercultural Studies, and ***Whole Earth***

"Never doubt that a small group of thoughtful, committed citizens can change the world."
– Margaret Mead

When Margaret Mead died in 1978, she was the most famous anthropologist in the world. In her honor, having started in 1999 and continuing through the centennial year of her birth in 2001, *Whole Earth* and Margaret Mead's foundation, the Institute of Intercultural Studies, come together to honor small groups of thoughtful, committed citizens who have changed the world.

Mead always believed in the human capacity to change, insisting that the cultural habits of racism, warfare, and environmental exploitation are learned. She promoted human diversity as a teaching tool; pointed to modified traditions and new institutions that had successfully adapted to a changing world; and praised groups who were inspirations, models, and vehicles for learning from one another. Her goal was nothing less than intercultural and international understanding as a foundation for human freedoms.

If you know of a small group (fewer than 100 people) anywhere on the planet that has worked to change the world; that has cross-connected issues such as race, environment, intergenerational learning, child rearing, and gender understanding; that has developed an organization or series of tools that others can learn from; and that takes a long view of cultural understanding, please send your nominations to:

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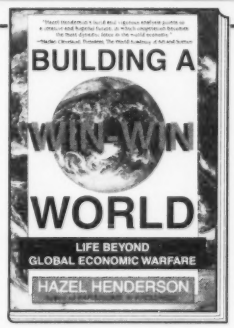

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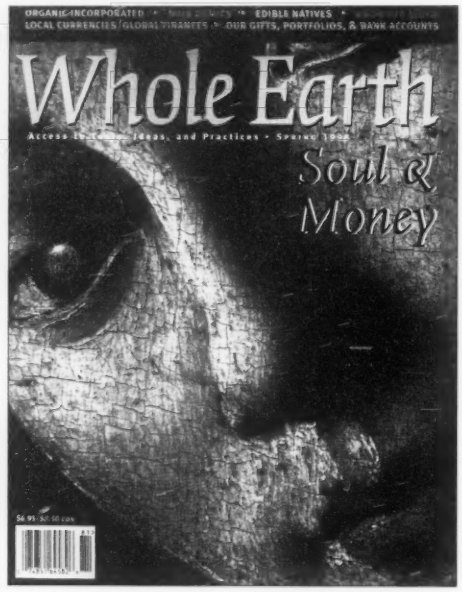

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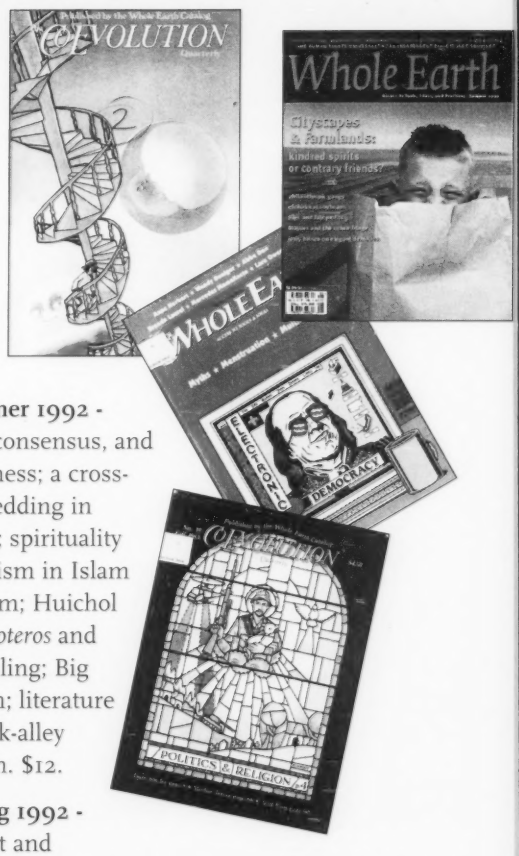

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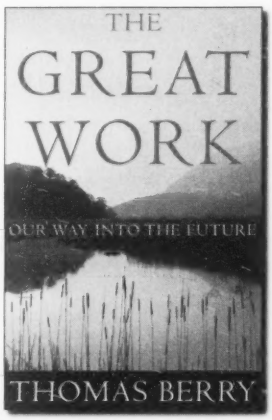

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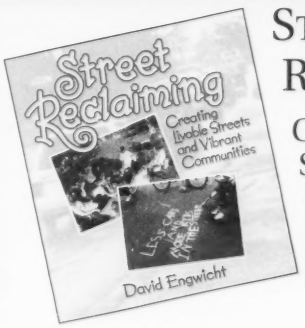

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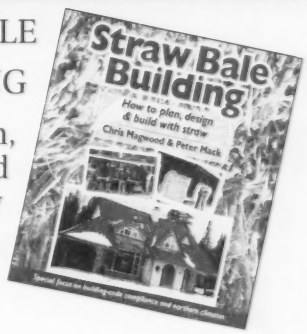

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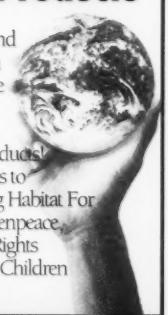

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